

Aug. 27, 1929.

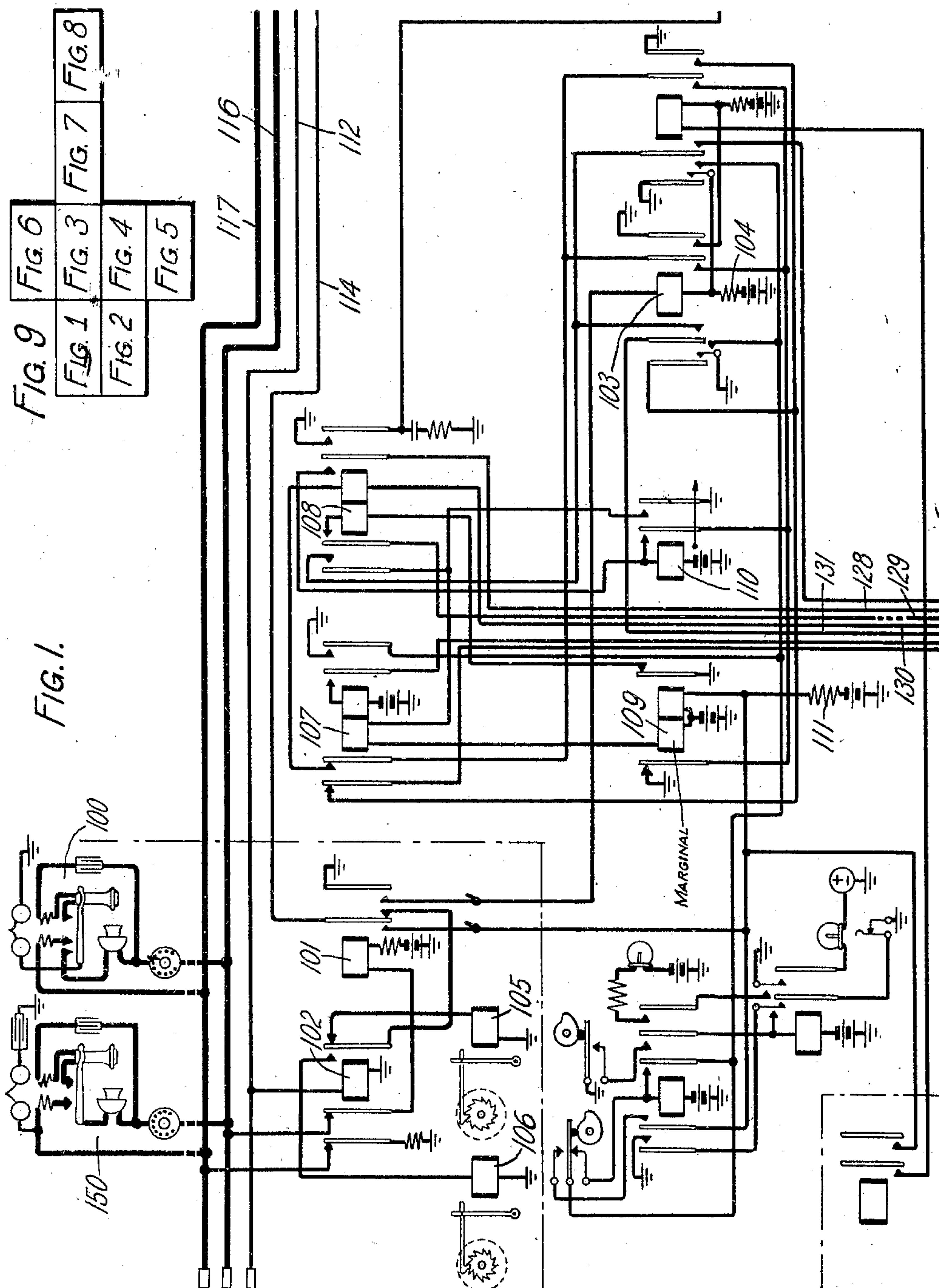
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1,725,757

CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed Nov. 11, 1927

8 Sheets-Sheet 1



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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed Nov. 11, 1927

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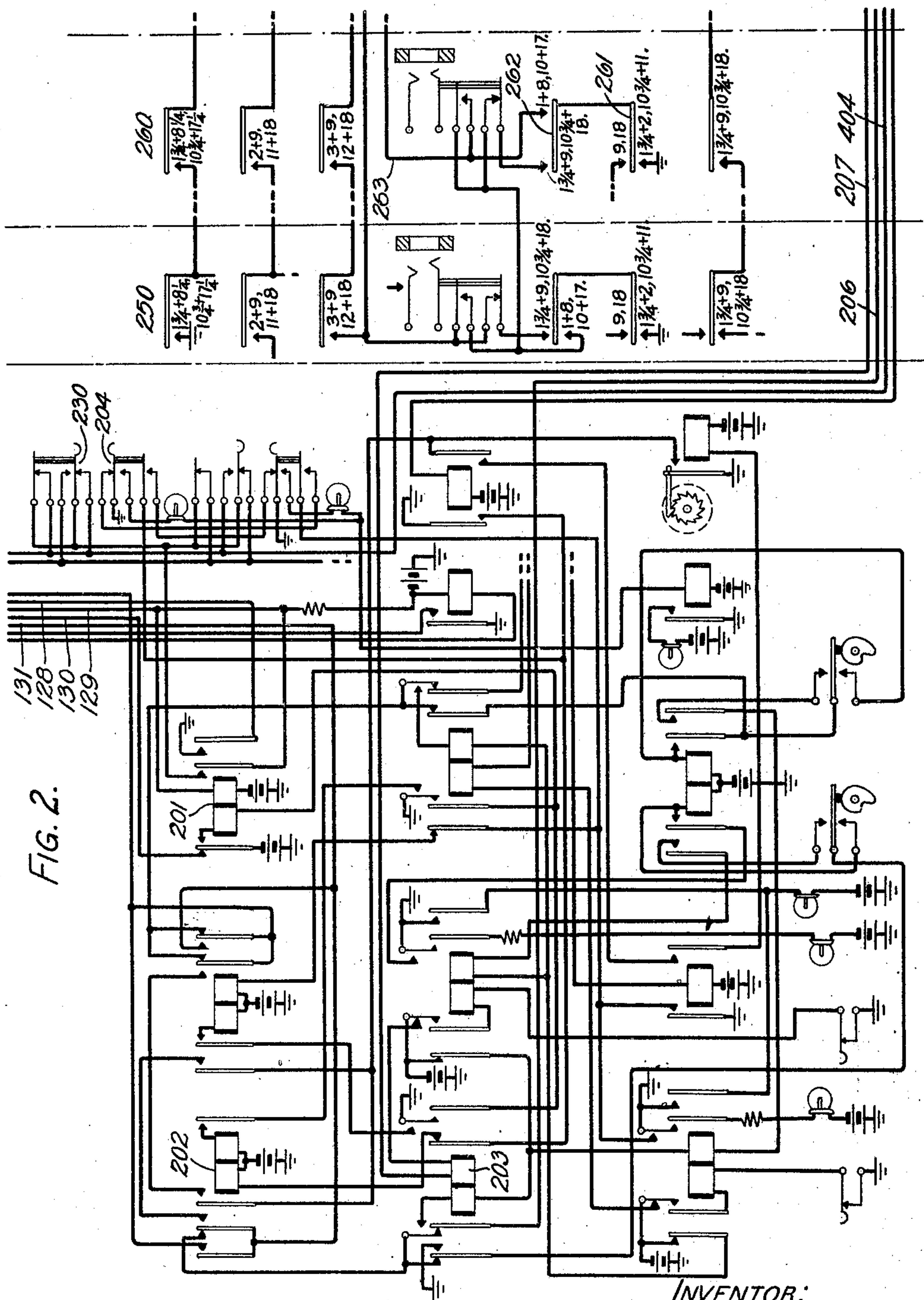


FIG. 2.

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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

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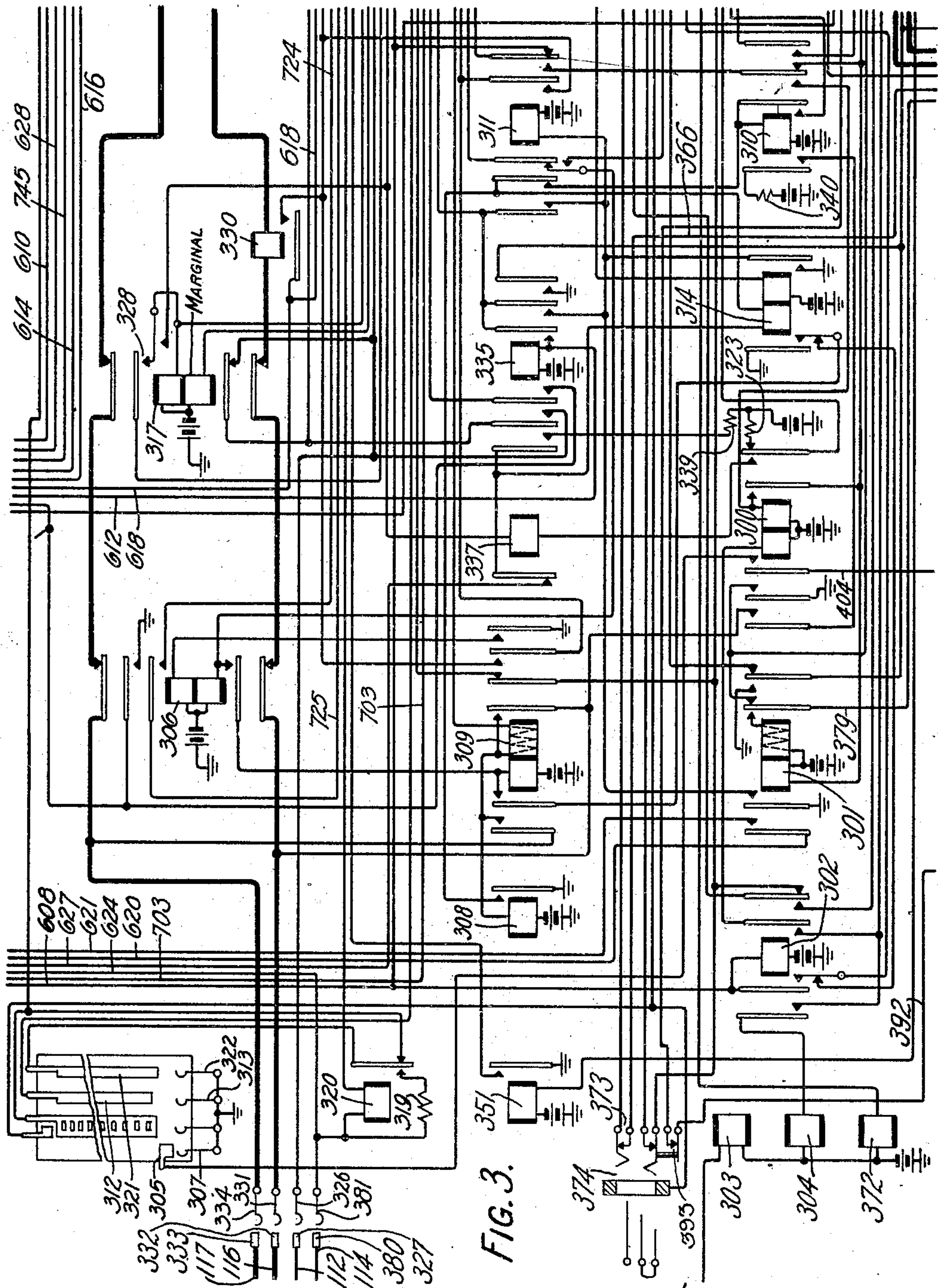


FIG. 3.

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1,725,757

CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed Nov. 11, 1927

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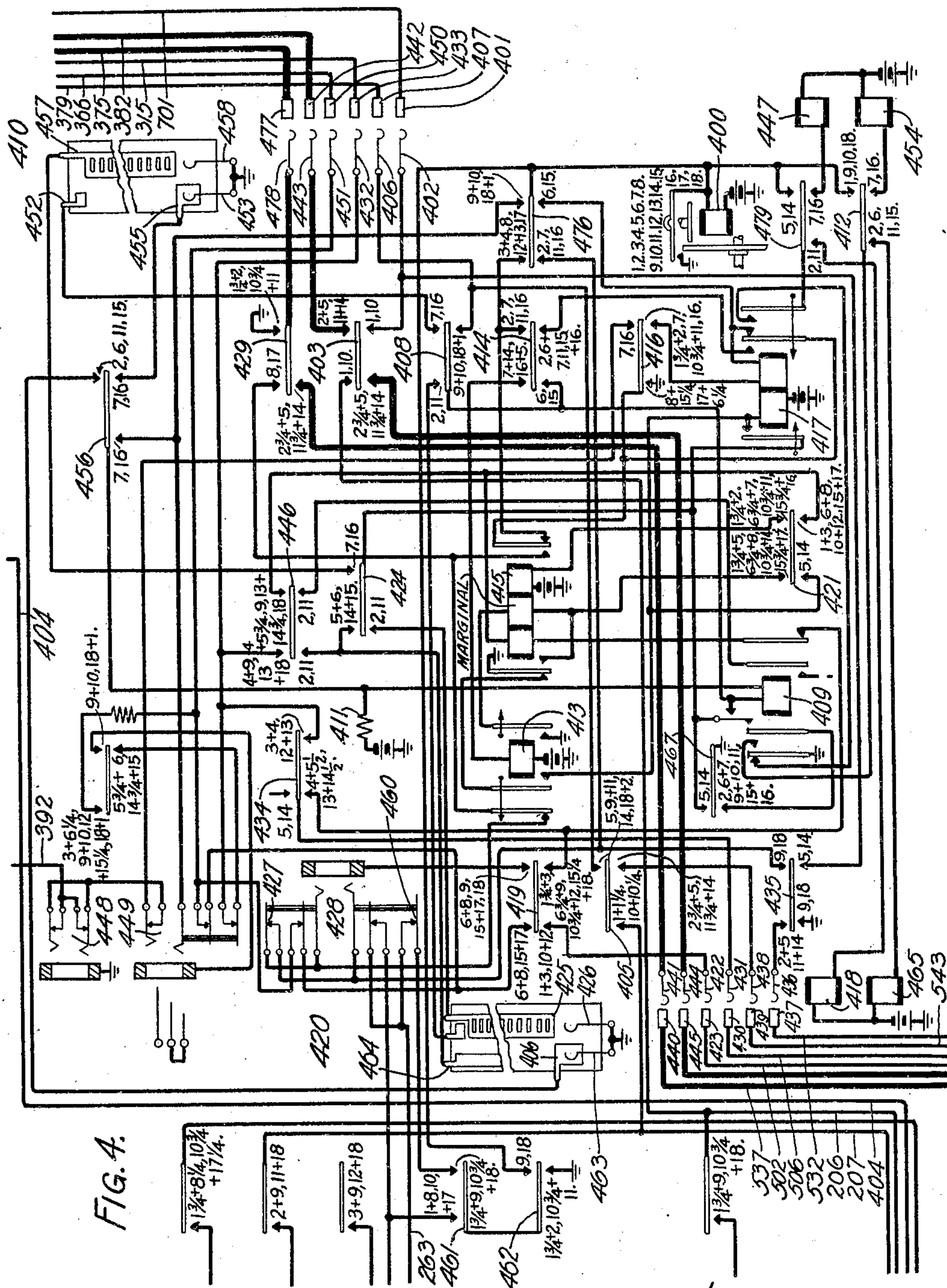


FIG. 4.

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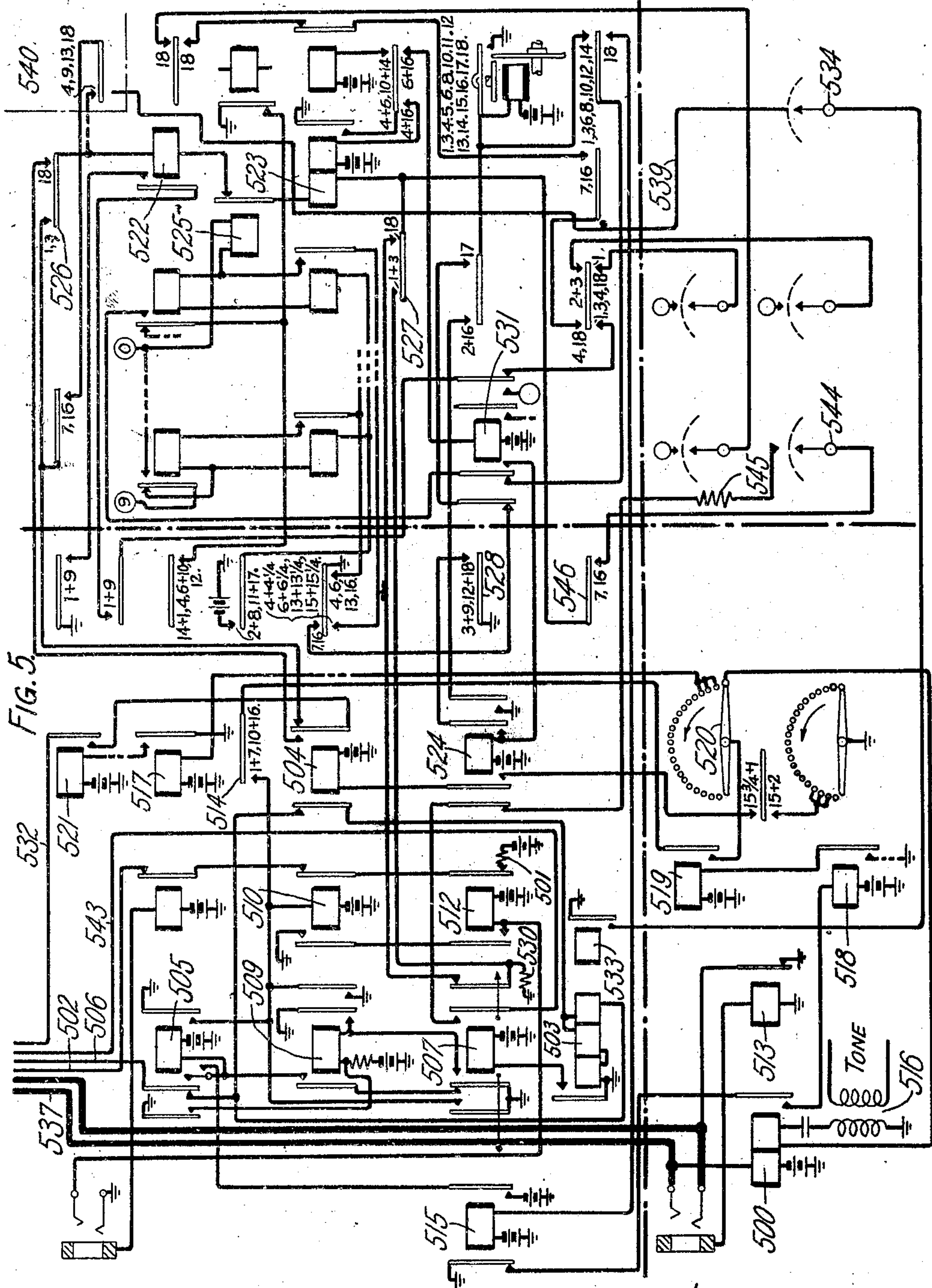
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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed Nov. 11, 1927

8 Sheets-Sheet 5



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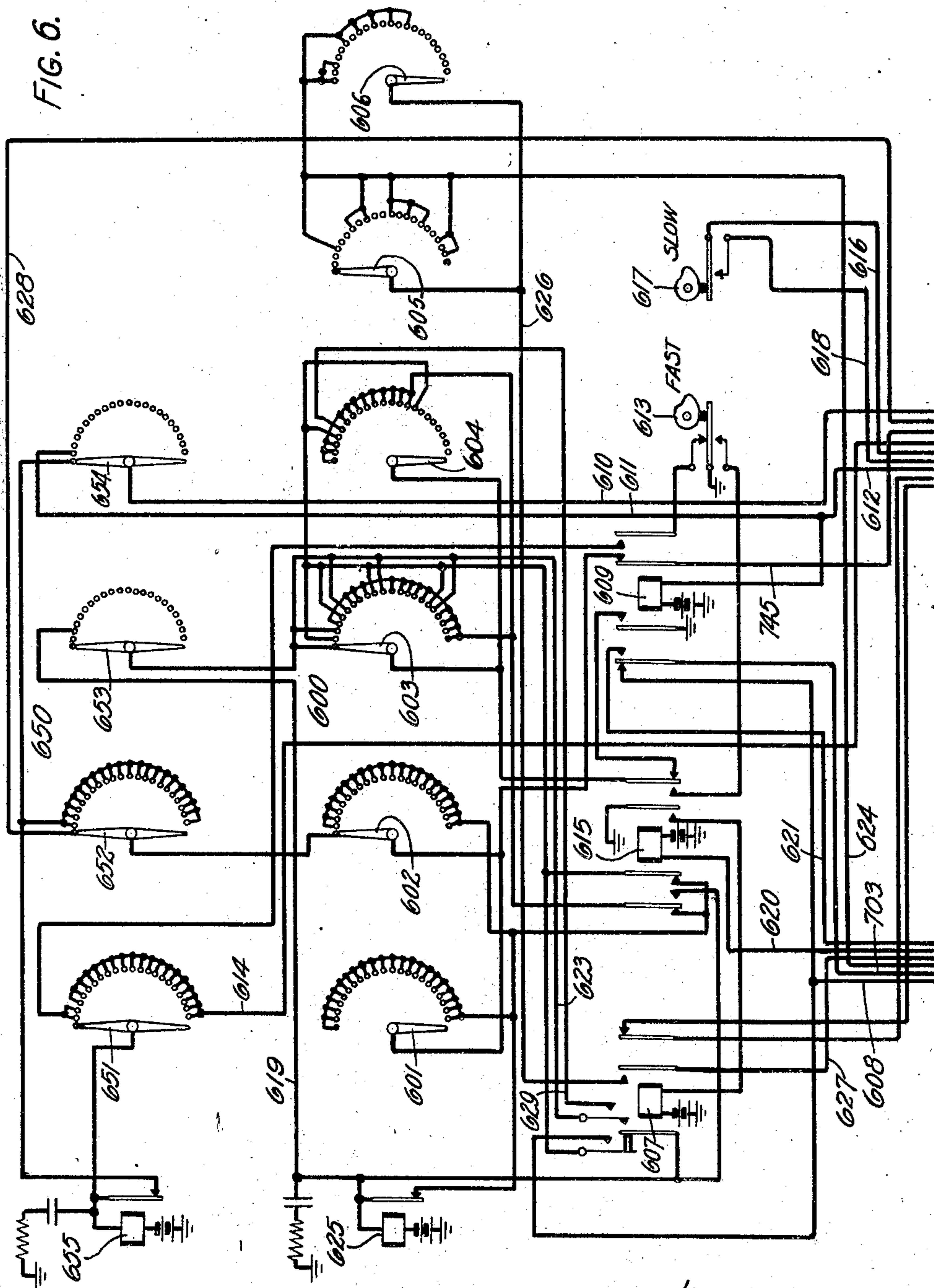
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8 Sheets-Sheet 6



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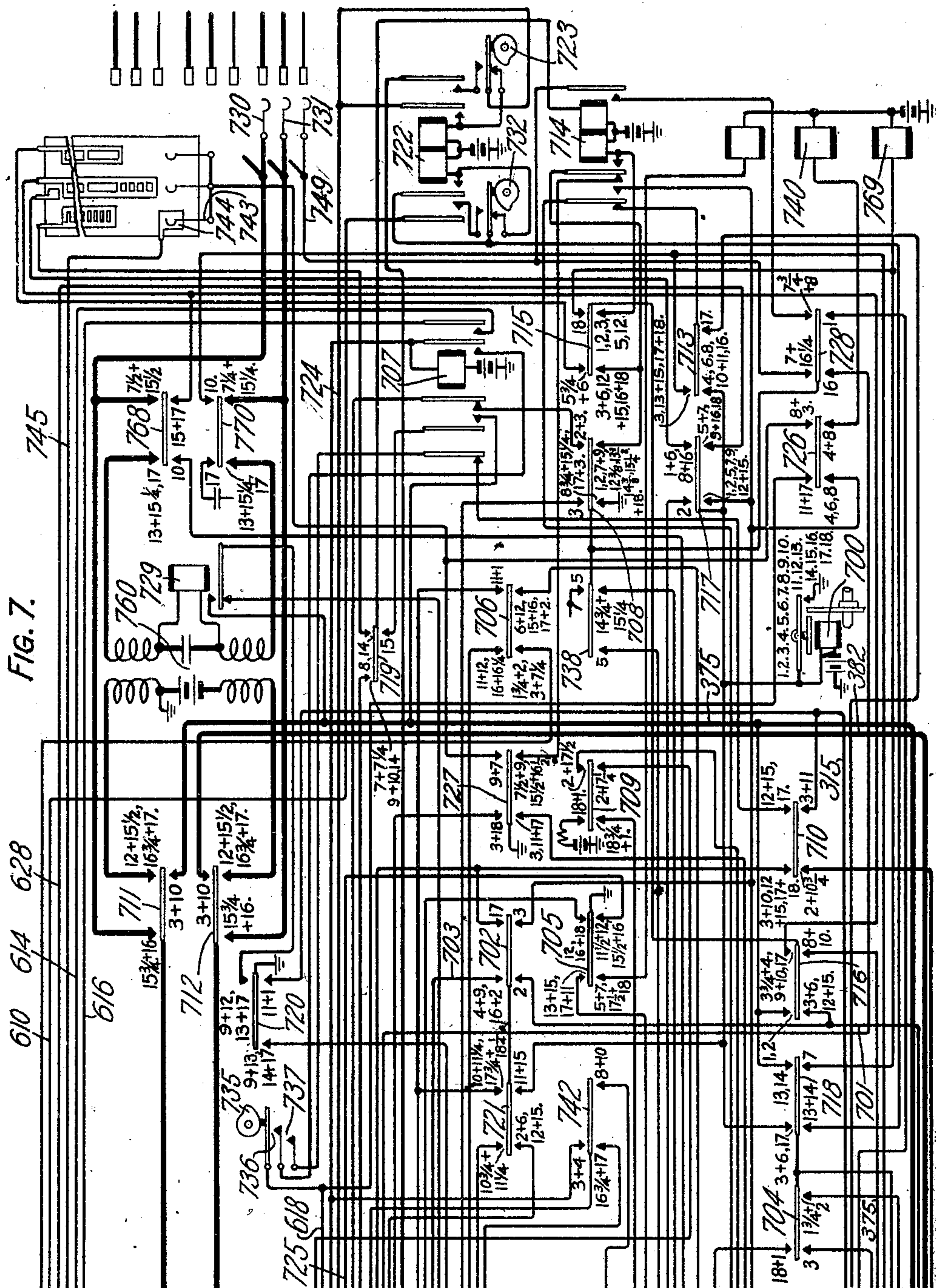
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8 Sheets-Sheet 7



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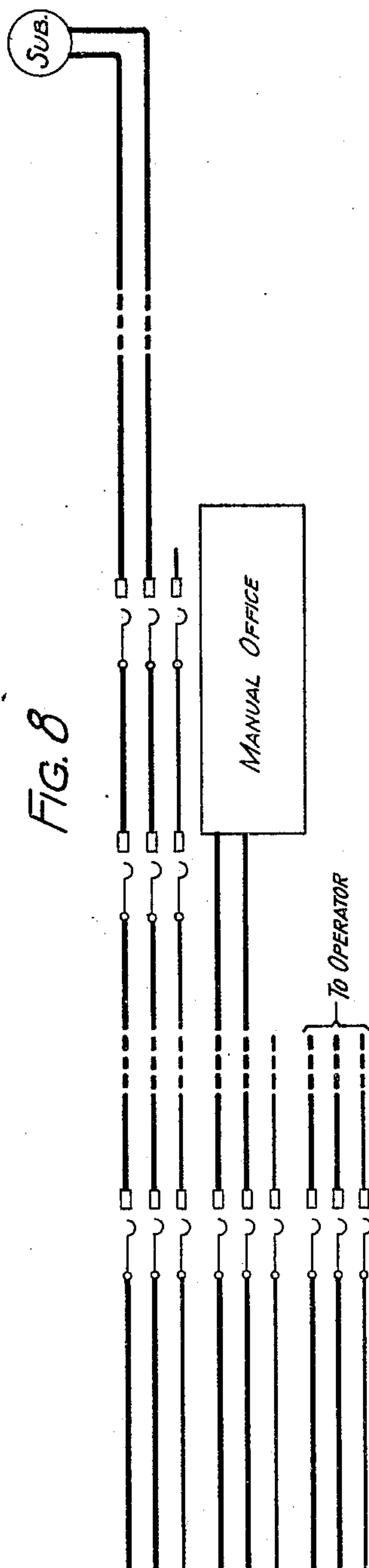
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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

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8 Sheets-Sheet 8



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UNITED STATES PATENT OFFICE.

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CALL-CHARGING TELEPHONE-EXCHANGE SYSTEM.

Application filed November 11, 1927. Serial No. 232,595.

This invention relates to a telephone exchange system and more particularly to a system in which a charge is automatically made for a completed call. The object of the invention is the provision of means for controlling the call charging, which will charge the calling subscriber in such a manner as to more equitably recompense the operating telephone company for the use of exchange equipment.

It is not equitable to the operating telephone company that for a basic charge a subscriber shall be enabled to hold an established connection indefinitely. In manual systems, of course, the operator is able to assess the charge in accordance with the number of unit periods during which conversation is continued on any call. Where, however, calls are extended by means of machine switching devices, operator supervision is not desirable, and from a standpoint of economy the supervision of elapsed time should be attained by automatic means.

Automatic charging in accordance with the elapsed conversational period has heretofore been accomplished. In accordance with the present invention, however, one specific embodiment of which is disclosed herein by way of illustration, this is accomplished in the following improved manner:

A timing switch is provided which is started upon the response of the called subscriber and under the control of a timing interrupter completes its cycle once during each unit period of conversation, the unit period having been chosen as that which would be proper for a single unit charge, for example, five minutes. The timing switch advances a recording switch to a position which is indicative of the number of such periods elapsing during the conversation. Upon the termination of the call the recording switch is then further advanced, sending a number of impulses for operating the subscriber's message register to charge the call in accordance with the position it assumed in its initial setting. Registration is thus effected in accordance with the elapsed time for the terminated conversation.

A clearer conception of the scope and purpose of the invention will be obtained from a consideration of the following description,

taken in connection with the attached drawings, in which:

Figure 1 shows a calling subscriber's line having two substations thereon, together with certain relays for preventing interference between calling lines;

Fig. 2 shows a start circuit and a portion of two link circuits;

Fig. 3 shows a line finder;

Fig. 4 shows a link circuit for associating the sender of Fig. 5 with the district selector of Fig. 7;

Fig. 5 shows a portion of a register sender;

Fig. 6 shows a call charging control circuit;

Fig. 7 shows a district selector;

Fig. 8 shows in schematic form selectors for completing a connection to an automatic subscriber, to a manual office or to an operator, and

Fig. 9 shows the manner in which Figs. 1 to 7 should be arranged.

The invention has been embodied in a disclosure which is substantially like that of Patent 1,567,072 to W. H. Matthies, granted December 29, 1925. Both the present disclosure and that of the Matthies patent show a skeletonized sender substantially identical with that employed in the more complete disclosure of Patent 1,589,402 to O. H. Kopp, granted June 22, 1926. Reference to the Kopp patent is made for operations not completely described herein.

As in the case of the above mentioned patents, a plurality of link circuits are arranged to serve a group of calling lines and are taken into service in rotation. When a link circuit completes its function it hunts for and associates itself with a district selector which is ready for use and the link and district remain in a sub-allotted condition until the next link in the series has been put into service. The link circuit is then put into allotted condition, from which it will be advanced by the initiation of a call and the action of the start circuit of Fig. 2. The trip circuit of Fig. 1 and the start circuit of Fig. 2 are so arranged that only one line may be served at a time and so that there may be cooperation between two groups of lines, to each of which a group of link circuits is individual. The details of these

functions are described in the above mentioned Matthies patent and since they form no part of the present invention will be omitted from the following description.

5 *Establishment of connection.*

It will first be assumed that the subscriber at substation 100 removes his receiver from the switchhook to initiate a call, thereby
10 closing a circuit from battery through the winding of line relay 101, inner left contact of relay 102 over the subscriber's line to ground at the outer left contact of relay 102. Relay 101 in operating closes a circuit
15 from battery through resistance 104, winding of relay 103 to ground at the outer front contact of relay 101. It also prepares a circuit from battery through resistance 111 and the right winding of relay 109 in parallel, inner front contact of relay 101 to
20 conductor 114, to identify the calling line to the line finder. Relay 103 in operating closes a circuit from battery, over the left back contact of relay 201, conductor 130,
25 right winding of relay 108, inner left contact of relay 107, inner right contact of relay 103 to ground at the left contact of relay 109.

Relay 108 operates in this circuit and closes
30 a locking circuit for itself from battery through the right winding of relay 201, conductor 129 over back contacts of relays similar to relay 108 individual to other groups of lines appearing before the same line finder,
35 inner left front contact and left winding of relay 108 to ground at the right contact of relay 109. Relay 108 prepares a circuit from ground at its outer right contact through the winding of trip magnet 303 of
40 the line finder to battery in preparation for tripping the proper set of brushes when the line finder is operated. Relay 201 operates in the locking circuit of relay 108 and in combination therewith closes a circuit from
45 ground over its outer right contact, conductor 128, inner right contact of relay 108, winding of relay 110 to battery. Relay 110 locks over its inner right contact to ground at the left contact of relay 109. Relay 110 closes
50 a circuit for starting the allotted line finder. Assuming that the link and line finder shown are the ones to be used next, sequence switch 400 will be standing in position 1 and sequence switch 700 in position
55 2. The operation of relay 110 will therefore close a circuit from ground at its outer contact, outer left contact of relay 108, inner left contact of relay 103, conductor 131, left back contact of relay 202, inner left back
60 contact of relay 203, conductor 206, upper left and lower right contacts of cam 403, brush 402 and terminal 401, conductor 701, left contacts of cam 702, conductor 703, outer left back contact of relay 609, conductor 608,
65 winding of relay 302 to battery.

Relay 302 in operating closes a circuit from battery through the winding of up-drive magnet 304 of the line finder, outer
left contact of relay 302, lower right contact of cam 704, outer right front contact of re-
70 lay 302, upper left contact of cam 705 to ground. The line finder moves upward under the control of magnet 304 and since trip magnet 303 is operated the proper set of
brushes is tripped. As soon as the line find-
75 er moves upward a locking circuit is provided for relay 302 extending over its inner left contact, lower contacts of cam 706, right back contact of relay 320, commutator strip
80 321, brush 322 to ground, which holds relay 302 operated independent of the start circuit. At its inner right front contact relay 302 establishes a circuit for relay 300,
extending from battery through the left
winding of relay 300, inner right contact of
85 relay 302, lower right contact of cam 704 to ground, as previously traced at the upper left contact of cam 705. As soon as commutator brush 307 engages segment 305, a
circuit is closed from ground, over brush
90 307 and segment 305, the innermost left contact of relay 300, conductor 404, contact 230 of key 204, inner right front contact of relay
201, to conductor 129 and the right winding
95 of relay 201. This circuit shunts the winding of relay 108 and causes that relay to release, in turn releasing the trip magnet 303. When brush 307 leaves segment 305, the circuit of relay 201 is opened and that relay also
100 releases.

When line finder brush 381 makes contact with terminal 380, which is connected to conductor 114 and therefore to battery, a
circuit is completed from this battery
through the winding of relay 320, inner left
105 back contact of relay 707, upper right and lower left contacts of cam 708 to ground. Relay 320 operates in this circuit and closes a shunt around its winding through resistance 319 to ground over commutator strip
110 321 and brush 322. This reduces the resistance in series with the winding of marginal relay 109 sufficiently to cause that relay to operate and to open the locking circuit of
115 relay 110, which in turn opens the energizing circuit of relay 302. The operation of relay 320 also opens the locking circuit of relay 302, causing that relay to release. The
release of relay 302 opens the circuit of the
up-drive magnet 304 to arrest the hunting
120 movement of the line finder and opens the circuit of relay 300, which also releases. The release of relay 300 closes a circuit from ground through the winding of cut-off re-
lay 102, conductor 112, terminal 327, brush
125 326, innermost lower back contact of relay 317, right contacts of cam 709, right back contact of relay 300, resistance 323 to battery. The operation of cut-off relay 102
opens the circuit of line relay 101, removing
130

battery from conductor 114, thus releasing relays 109 and 320.

At the time relay 300 operates it closes a circuit from ground at its middle left contact over the inner right back contact of relay 301, conductor 379, terminal 407 and brush 406 of the link district finder 410, lower right contact of cam 408, winding of relay 409, resistance 411 to battery. Relay 409 operates and closes a circuit from battery through the winding of sequence switch magnet 400, upper contact of cam 412 to ground at the outer left front contact of relay 409, advancing the link sequence switch 400 to position 2. When sequence switch 400 leaves position 1, relay 409 is released. In position 2 a circuit is closed from battery through the winding of relay 413, upper contacts of cam 414, right back contact of relay 415 to ground at the left contact of cam 416. Relay 413 operates, closing a circuit from battery through the left winding of relay 417, left front contact of relay 413 to ground at the left back contact of relay 415. Relay 417 upon operating closes a circuit from battery through the winding of up-drive magnet 418 of the sender finder 420, left contact of cam 479, outer right contact of relay 417 to ground at the left back contact of relay 409. The sender finder moves upward under control of magnet 418 in search of an idle sender.

Relay 413 also closes a circuit from battery through the right winding of relay 415, upper contacts of cam 421, middle winding of relay 415 to ground at the right contact of relay 413. The current in this circuit, however, is not sufficient to operate relay 415, but does create a flux in the windings of that relay so that it becomes quick to operate when the test circuit is closed. The test circuit extends from brush 422 over the lower contacts of cam 419, right back contact of relay 409, left winding of relay 415, lower right and upper left contacts of cam 421, middle winding of relay 415 to ground at the right contact of relay 413. An idle sender is characterized by battery connected to conductor 502. When, therefore, brush 422 engages terminal 423, corresponding to the sender of Fig. 5 which is assumed to be idle, the test circuit above traced is completed over terminal 423 to battery, and relay 415 operates quickly. The relay 415 upon operating, closes a locking circuit for itself from battery through its right winding, upper contacts of cam 421 to ground at its left front contact. It also opens the circuit of relay 417, which releases, in turn releasing magnet 418 and bringing the sender finder to rest on the terminals of the idle sender. The release of relay 417 in turn releases relay 413. When relay 413 releases with relay 415 operated, a circuit is closed from battery through the winding of se-

quence switch magnet 400, lower left contact of cam 476, contact 427 of jack 428, left back contact of relay 413, right front contact of relay 415 to ground at the left contact of cam 416, advancing sequence switch 400 to position 3.

When sequence switch 400 reaches position 3, a circuit is closed from ground through the left and middle windings of relay 503, left back contacts of relays 504 and 505, conductor 506, terminal 430, brush 431, right contact of cam 434, brush 432 and terminal 433, conductor 315, contacts of cam 710 (assuming that the district selector has been advanced to position 3, as above described), through the lower winding of relay 317 and the winding of relay 351 in parallel to battery. Relay 317 is marginal and does not operate, but relay 351 operates, although ineffective at this time. Relay 503 also operates and closes an obvious circuit for relay 507, which in turn closes a circuit for relay 509. Relay 509 closes a circuit for relay 510.

As soon as sequence switch 400 arrived in position $2\frac{3}{4}$ it prepared the pulsing circuit for receiving dial pulses. This circuit may be traced from battery through the left winding of relay 500, conductor 537, terminal 440, brush 441, lower contact of cam 429, brush 478, terminal 477, conductor 375, lower right contact of cam 711, upper back contact of relay 317, upper back contact of relay 306, brush 334, terminal 333, conductor 117 through the subscriber's substation, conductor 116, terminal 332, brush 331, lower back contact of relay 306, lower back contact of relay 317, winding of relay 330, upper right contact of cam 712, conductor 382, terminal 442, brush 443, upper right and lower left contacts of cam 403, brush 444, and terminal 445, to ground at the back contact of relay 513. Relay 500 operates, in turn operating relay 518 in the well known manner, relay 518 operating relay 519. A circuit is thereupon closed from the source of tone 516, through the right winding of relay 500, register steering switch brush 520 in its normal position, front contact of relay 519, contact of cam 514 to ground at the outer right front contact of relay 509. This tone is transmitted to the calling subscriber to inform him that the sender is ready to receive impulses which he may then send out by manipulating his dial. When relay 510 operated it removed battery from conductor 502, releasing relay 415. When relay 415 releases, a circuit is closed from battery through the winding of sequence switch magnet 400, upper left contact of cam 476, right back contact of relay 415 to ground at the left contact of cam 416. Sequence switch 400 advances to position 5 over this circuit and remains in this position throughout the further operation of the sender.

The calling subscriber now proceeds to

dial the desired line number for setting the registers and translator (not shown) of the sender in the well known manner. After the dialing of the first digit the register steering switch, one wiper of which is shown at 520, advances from normal closing a circuit for relay 517, extending from battery through the winding of relay 517, terminals and brush 520, contact of relay 519, contact of cam 514 to ground at the outer right contact of relay 509. Relay 517 closes an obvious circuit for relay 521.

As soon as the code registers of the sender have been set in accordance with the first two digits dialed by the calling subscriber, the translator is set in the manner described in the aforementioned patent to O. H. Kopp. When the translator assumes its setting relay 533 operates, closing a circuit over the translator arc 534, over the cable 539 to the class switch 540 which is diagrammatically indicated in the upper right portion of Fig. 5. The class switch is thereupon set from the arc 534 of the translator.

When the link circuit advances into position 2 for hunting for an idle sender, a circuit is closed for relay 714 extending from battery through the left winding of relay 714, lower right contact of cam 715, upper left contact of cam 716, conductor 375, terminal 477 and brush 478 of district finder 410, to ground at the right contact of cam 429. When relay 302 releases and relay 714 energizes, a circuit is closed for advancing sequence switch 700 into position 3, extending from battery through magnet 700, the lower left contact of cam 717, outer left front contact of relay 714, right back contact of relay 302 to ground at the upper left contact of cam 705. As the sequence switch 700 advances from position 2 to 3, relay 714 releases.

When sequence switch 700 is in position 3 a circuit is closed to test the responsive condition of relay 308. This circuit extends from battery through the winding of relay 308, the right winding of relay 309 to ground through the left contacts of cam 708. The current flow received by relay 308 at this time is the least upon which the relay should operate. If relay 308 operates, as it should, a circuit is closed for relay 310, extending from battery through the winding of relay 310, outer left back contact of relay 311 to ground at the contact of relay 308. Relay 310 locks over its inner right front contact to ground at the lower left contact of cam 727 and prepares a circuit for advancing sequence switch 700 into position 4. With sequence switch 700 in position 3, relay 714 is again energized over a circuit extending from battery through its left winding, the lower right contact of cam 715, the lower left contact of cam 716, conductor 701, terminal 401 and brush 402 of district finder

410, the lower right and upper left contacts of cam 435, brush 436 and terminal 437 of sender finder 420, the front contact of relay 521, the right back contact of relay 504, the left contact of cam 526, winding of sender stepping relay 522, winding of overflow relay 523, left contact of cam 527, resistance 530 to ground. Relays 522 and 714 operate in this circuit, relay 714 locking over its inner left front contact and the lower left contact of cam 715, thence over the circuit traced whereby it remains energized as the sequence switch 700 advances into position 4. Relay 714 also closes a circuit to advance sequence switch 700 into position 4, extending from battery through magnet 700, upper left contact of cam 718, lower left contact of cam 704, outer right contact of relay 310, outer left front contact of relay 714, right back contact of relay 302 to ground at the upper left contact of cam 705. As soon as sequence switch 700 leaves position 3, relays 308 and 310 release.

The district selector is now controlled by the sender in its brush and group selections and then proceeds to hunt for an idle trunk in the well known manner. After an idle trunk is selected, a circuit is established in position 9 for relay 714, extending from battery through the right winding of this relay, the left contact of cam 719 to ground at the contact of relay 351, advancing the sequence switch 700 into position 10. In position 10 relay 714 remains energized over the circuit just traced. In position 10, which is the selection beyond position of the district circuit, the control of succeeding switches is effected over a fundamental circuit which may be traced in part through the upper right and lower left contacts of cam 768, outer right back contact of relay 301, conductor 701, thence as traced to the sender through relays 522 and 523, cam 546, brush 544, compensating resistance 545, left back contact of relay 524, right front contact of relay 507, conductor 543, returning over terminal 439 and brush 438, the right contacts of cam 405, brush 406 and terminal 407, conductor 379, the inner right back contact of relay 301 to the right contacts of cam 770.

As soon as selections are completed and the connection has been set up to the called subscriber's line, reversed battery from the incoming selector operates relays 522 and 523 in the usual manner. These relays in turn cause the operation of relay 531 and relays 524 and 504. With these relays operated, the sender is advanced to position 18 for controlling talking selection. Relay 351 is operated in parallel with the winding of relay 317 throughout selections. The operation of relay 504 above mentioned now opens a shunt around the right winding of relay 503, including that winding in the circuit

of relays 351 and 317. Relay 351 thereupon releases, in turn opening the circuit of relay 714, which also releases. Upon the release of relay 714 the district sequence switch 700 is advanced into position 12 over a circuit extending from battery, winding of magnet 700, lower left contact of cam 713, outer left back contact of relay 714, outer right back contact of relay 302 to ground at the upper left contact of cam 705. As the sequence switch enters position 11, ground is connected to conductor 315 at the lower right contact of cam 720, which is extended over terminal 433, brush 432, upper contacts of cam 446, left winding of relay 415, right back contact of relay 409, left contact of cam 434, brush 431, terminal 430, conductor 506, left back contact of relay 505 to the windings of relay 503. Since these windings are also connected to ground, relay 503 now releases, in turn releasing relay 507. The release of relay 507 does not release relay 509, since that relay is locked to its own front contact. A circuit is therefore closed from ground over the left back contact of relay 507, front contact of relay 509 to the winding of relay 505, which relay locks over its middle left contact to conductor 506 and to ground as above traced. After leaving position 11, relays 351 and 317 are both disconnected from conductor 315. After leaving position 10, the subscriber's line becomes disconnected from the sender at contacts of cams 711 and 712.

Test for particular calling substation

In positions 11 and 12 of sequence switch 700 a test of the calling line is made by the relay 308 to determine which party on the line has initiated the call. As the sequence switch passes through positions $10\frac{3}{4}$ to $11\frac{1}{4}$ a circuit is established for relay 306 extending from battery, lower winding of relay 306, inner left back contact of relay 311, upper contacts of cam 721, commutator segment 312, brush 313 to ground. Relay 306 upon operating extends its own operating ground over its lower front contact to battery through the left winding of relay 309, energizing the latter relay. Relay 309 upon energizing locks both itself and relay 306 over its inner left front contact, the left normal contacts of relay 314, the left normal contacts of relay 302, the right contacts of cam 706 to ground over commutator segment 312 and brush 313. Relay 309 at its outer right front contact also closes a secondary holding circuit for relay 306 through its upper winding. Relay 309 also connects the winding of relay 308 to brush 331 of the line finder through the inner right contact of relay 309 and to brush 334 over the outer left contact of relay 309. Since the substation 100 has been assumed to be calling, these

circuits will be completed to ground over terminal 332, conductor 116, through the ringer at substation 100 and over terminal 333, conductor 117, switchhook contacts thence to ground through the ringer, and relay 308 will energize in turn operating relay 310, the latter relay locking to ground at the lower left contact of cam 727.

Relay 306 also closes a circuit for relay 722, extending from battery through the right winding of relay 722, the lower contact of interrupter 723, conductor 724, the inner upper front contact of relay 306, conductor 725 to ground at the lower right contact of cam 705. Relay 722 locks independently of interrupter 723 over its inner right contact to the circuit above traced. When relay 722 energizes, as soon as interrupter 723 makes its upper contact a circuit is closed through the winding of relay 302, the outer right contact of relay 722, the upper contact of interrupter 723, conductor 724, innermost upper front contact of relay 306, conductor 725 to ground at the lower right contact of cam 705. Relay 302 upon energizing opens the holding circuit of relay 309, which releases, in turn releasing relays 306, 722 and 302. The timing interrupter 723 is so arranged that relays 306, 309 and 722 do not release until relay 308 has had time to operate and to lock relay 310 energized.

The release of relay 306 now connects the left windings of repeating coil 760 to the subscriber's line, the calling subscriber being supplied with talking current over the following path: battery, lower left winding of coil 760, lower right contact of cam 712, winding of supervisory relay 330, lower back contacts of relays 317 and 306, brush 331, terminal 332, conductor 116 through the substation set 100, returning over conductor 117, terminal 333 and brush 334, upper back contacts of relays 306 and 317, upper right contact of cam 711 to ground through the upper left winding of repeating coil 760. Relay 330 operates in this circuit and closes a circuit for relay 707, extending from battery through the winding of relay 707, contact of relay 330, upper contacts of cam 726 to ground at the upper right contact of cam 727.

Talking selection.

With sequence switch 700 in position 12, relay 714 is energized in a circuit extending to the sender from battery through its left winding, the lower right contact of cam 715, the lower left contact of cam 716, conductor 701, terminal 401, brush 402, the lower right and upper left contacts of cam 435, brush 436, terminal 437, conductor 532, the front contact of relay 521, the front contact of relay 504, the right contact of cam 526,

the sender sequence switch being in position 18 for talking selection, the windings of relays 522 and 523, the right contact of cam 527 to ground through resistance 530. Relays 714 and 522 energize in this circuit, relay 714 closing a circuit extending from battery through sequence switch magnet 700, the lower left contact of cam 717, the outer left front contact of relay 714, the right back contact of relay 309 to ground at the upper right contact of cam 705. Relay 714 upon energizing locks to the fundamental circuit over its inner left front contact and the lower left contact of cam 715. As sequence switch 700 rotates out of position 12 toward position 16 ground is intermittently connected to the fundamental circuit in shunt of sender stepping relay 522 at the lower contacts of cam 708. When the sender is satisfied as to its talking selection setting, the fundamental circuit is opened at the sender through the operation of relay 525, and relay 714 deenergizes, arresting sequence switch 700 in its next stopping position. The sequence switch may be arrested in any one of three positions; position 13 which may be a no-charge position, position 14 which is a charging position, and position 15 for connections to an operator's position.

At the sender after talking selection is completed, relay 515 operates connecting battery to conductor 506 in parallel with the winding of relay 505. The current in this circuit is now sufficient to operate relay 415 which closes a circuit from battery through the left winding of relay 417, left contacts of cam 421, to ground at the left front contact of relay 415. Relay 417 closes a circuit from battery through the winding of sequence switch magnet 400, upper contact of cam 479, outer right front contact of relay 417, left back contact of relay 409 to ground, advancing sequence switch 400 to position 6. In this position, all of the conductors extending to the sender are opened and the sender is completely released. As soon as sequence switch 400 leaves position 5, relay 415 releases and in turn releases relay 417 unless the sender finder 420 is standing on one of its top ten terminals. If the latter is true, relay 417 is held operated in a circuit from battery over its left winding, left front contact, upper left contact of cam 424, commutator segment 464, brush 463 to ground. With relay 417 operated at this time, a circuit is closed from battery through resistance 411, winding of relay 409, lower contacts of cam 414, inner right front contact of relay 417, lower left contact of cam 416 to ground. Relay 409 locks through its inner left contacts to ground at the lower contact of cam 467 and also closes a second locking circuit

for relay 417. With relay 409 operated, a circuit is closed from battery through the winding of down-drive magnet 465 of the sender finder 420, left contact of cam 412, to ground at the outer left front contact of relay 409. When the sender finder reaches its lowermost position, a circuit is closed from ground over brush 463, bottom commutator segment 406, upper contact of cam 456 to resistance 411, shunting the winding of relay 409 and causing that relay to release and in turn release relay 417. With relay 417 released in position 6, a circuit is closed from battery through the winding of sequence switch magnet 400, lower right contact of cam 476, right back contact of relay 417, to ground at the lower left contact of cam 416, advancing sequence switch 400 to position 7.

When sequence switch 400 reaches position 7, the link circuit is ready to associate itself with another district. If another district is standing in position 1 waiting association with a link, a circuit will be closed from ground over the lower left contact of cam 708 and lower right contact of cam 728 of that district, contact 393 of jack 374, conductor 392, contact of jack 448, contact of jack 449, upper contact of cam 416, right back contact of relay 415, upper contacts of cam 414, winding of relay 413 to battery. Relay 413 closes a circuit from battery through the left winding of relay 417, left front contact of relay 413, to ground at the left back contact of relay 415. Relay 417, in operating, closes a circuit for up-drive magnet 447 of the district finder 410, lower right contact of cam 479, right front contact of relay 417, left back contact of relay 409, to ground. The district finder moves upward under control of magnet 447 in search of the district which is awaiting a link. Such a district is identified by battery connected over the left contacts of cam 709 of that district, contact 373 of jack 374, to conductor 366. Relay 413, in operating, closes the same circuit through the right and middle windings of relay 415 as it closed in position 2. At this time the test circuit extends from ground at the right front contact of relay 413, through the middle winding of relay 415, upper left and lower right contacts of cam 421, left winding of relay 415, right back contact of relay 409, lower right and upper left contacts of cam 419, contact of jack 449 to brush 451.

If the district for which the district finder is hunting does not lie between the last position occupied by the finder and the top of its bank, it will continue to move upward until brush 453 engages segment 452, completing a circuit over the upper right contact of cam 408, winding of relay 409, resistance 411 to battery. The operation of

relay 409 opens the test circuit, opens the circuit of up-drive magnet 447 and closes a circuit from battery through the winding of down-drive magnet 454, lower right contact of cam 412, left front contact of relay 409 to ground. The district finder is restored to its lowermost position under the control of magnet 454, at which time a circuit is closed from ground over brush 453, bottom segment 455 of the district finder commutator, lower right contact of cam 456 to resistance 411, shunting and releasing relay 409 which restores the test circuit and the circuit of up-drive magnet 447. When brush 451 encounters terminal 450 to which conductor 366 extends, the test circuit is completed and relay 415 operates quickly as in the previous case. Relay 415 locks through its right winding, the upper contacts of cam 421, to ground at its left front contact, opening the circuit of relay 417 to deenergize magnet 447 and bring the district finder to rest on the terminals of the district. With relay 415 operated and relay 417 released, a circuit is closed from battery through the winding of sequence switch magnet 400, lower left contact of cam 476, contact 427 of jack 428, back contact of relay 413, right front contact of relay 415, upper right contact of cam 416, contacts of jacks 449 and 448 to conductor 392. Sequence switch 400 advances to position 8 in this circuit.

Relay 415 is held operated in position 8 from battery at the district over terminal 450, brush 451, contact of jack 449, upper left and lower right contacts of cam 419, back contact of relay 409, left winding of relay 415, lower right and upper left contacts of cam 421, to ground at the left front contact of relay 415. With relay 415 operated, a circuit is closed from ground at the left contact of cam 416, right front contact of relay 415, upper left contact of cam 429, brush 478, terminal 477, conductor 375, upper left contact of cam 716, lower right contact of cam 715, left winding of relay 714 to battery. Relay 714 operates and closes a circuit from battery through the winding of sequence switch magnet 700, lower left contact of cam 717, outer left front contact of relay 714, outer right back contact of relay 302, to ground at the upper left contact of cam 705. Sequence switch 700 advances to position 2 in this circuit, releasing relay 714. The advance to position 2 removes ground from conductor 392 and battery from conductor 366. The removal of battery from conductor 366 opens the circuit of relay 415, and that relay releases, closing a circuit from battery through the winding of sequence switch magnet 400, upper left contact of cam 476, right back contact of relay 415, to ground at the lower left contact of cam 416. Sequence switch 400 advances to position 9.

The link circuit remains in this position until the link circuit standing next to it in the series is advanced from position 1 for the purpose of selecting a sender. Link circuit 260 occupying that relationship to the link circuit of Fig. 4, a circuit may be traced from ground over the lower contact of cam 261, upper right contact of cam 262, conductor 263, contact 460 of jack 428, upper right contacts of cams 461 and 462, winding of sequence switch magnet 400 to battery, advancing the link circuit to position 10 which is the equivalent of position 1, so that the link circuit is ready to operate in response to the next call in the group of lines served thereby.

Charge calls initiated by substation 100.

It will first be assumed that the call which has been completed is of such a character that a charge should be made for it. For this call, therefore, the district sequence switch 700 has been set into position 14. When the called subscriber responds, a circuit is completed for relay 729 extending from the tip brush 730, over the upper contacts of cam 768, the upper right winding of repeating coil 760, winding of relay 729, lower right winding of coil 760, lower contacts of cam 770, to the brush 731. Relay 729 energizes and a circuit is established for relay 722 as soon as interrupter 732 closes its lower contact, from battery through the left winding of relay 722, the lower contact of interrupter 732, the lower left and upper right contacts of cam 718, the front contact of relay 729, to ground at the upper right contact of cam 720. Relay 722 upon energizing locks to ground at cam 720 over its inner left contact, independently of interrupter 732, and at its outer left contact prepares a circuit for advancing the timing switch 650 of the registration controlling circuit. This circuit may be traced from battery through the winding and armature contacts of magnet 655, the No. 1 terminal and brush 654 of switch 650, conductor 610, the outer left contact of relay 722, the upper contact of interrupter 732, thence to ground at the upper contact of cam 720. The timing switch advances to position 2 in which position ground on conductor 610 is extended over brush 654 and conductor 611, to battery through the winding of relay 609 and in parallel therewith over conductor 612 to battery through the winding of charging relay 335.

Relay 335 upon energizing locks over its inner right contact to ground at the left contact of cam 720, and at its intermediate right contact extends its locking ground through the winding of relay 311, energizing the latter relay. This locking ground also holds relay 609 energized after the tim-

ing switch advances out of position 2. Relay 609 upon energizing closes a circuit for further advancing the timing switch into position 4 under the control of the fast interrupter 613 which may be traced from battery, winding of magnet 655, brush 651 in positions 2 and 3, the right front contact of relay 609, the upper contact of interrupter 613 to ground. As soon as the timing switch reaches position 4 it is more slowly advanced under the control of the slow interrupter 617 in a circuit which may be traced from battery, through the winding of magnet 655, brush 651 and strapped terminals 4 to 22, conductor 614, the outer right front contact of relay 707, conductor 616, contacts of interrupter 617, conductor 618, upper contacts of cam 726 to ground at the upper right contact of cam 727. The interrupter 617 is designed to advance the switch 650 back to normal in approximately five minutes.

As the timing switch takes its initial steps, it advances the recording switch 600 off normal over a path extending from battery, winding of stepping magnet 625, conductor 619, brush 653 in position 3, brush 603 in position 1, the outer right back contact of relay 615, to ground at the inner left front contact of relay 609. When the recording switch reaches position 2 it automatically advances into position 3 over a circuit extending from battery, through the winding and interrupter contacts of magnet 625, inner left back contact of relay 615, No. 2 terminal and brush 603, right back contact of relay 615, to ground at the inner left front contact of relay 609.

If the conversation continues, the timing switch 650 starts a second revolution and again in passing through position 3 advances the recording switch 600 into position 4 over a circuit extending from battery, winding of magnet 625, conductor 619, brush 653 in position 3, brush 603 in position 2, the right back contact of relay 615 to ground at the inner left contact of relay 609. From position 4 the recording switch is automatically advanced into position 5 over a circuit extending from battery, winding and interrupter contacts of magnet 625, the outer left back contact of relay 615, terminal No. 4 on brush 603, thence to ground at the inner left contact of relay 609, and into position 6 over a circuit extending from battery, winding and interrupter contacts of magnet 625, the inner left back contact of relay 615, terminal No. 5 and brush 603 to ground at the inner left contact of relay 609.

It will first be assumed that the conversation is terminated during the second revolution of the timing switch and that therefore the recording switch remains standing in position 6. When the calling subscriber

hangs up to terminate the conversation relay 330 deenergizes, opening the energizing circuit of relay 707. Relay 707 is, however, held energized over its inner right front contact, contact 736 of interrupter 735, the upper contacts of cam 726 to ground at the upper right contact of cam 727 until the interrupter opens the contact 736. With relay 707 released the disconnect relay 317 energizes as soon as interrupter 735 again makes its contact 737, over a circuit extending from battery, lower winding of relay 317, upper contacts of cam 710, outer left back contact of relay 707, contacts 737 and 736 of interrupter 735 to ground over the upper contacts of cam 726 and the upper right contact of cam 727. The interrupter 735 in conjunction with relay 707 introduces a delay in the operation of relay 317 of approximately 0.25 seconds so that should the calling subscriber accidentally depress the switchhook the connection will not be wiped out. The operation of relay 317 disconnects the tip and ring conductors of the subscriber's line from the repeating coil 760 and closes a circuit for advancing sequence switch 700 to position 16. This circuit may be traced from battery, winding of magnet 700, lower contacts of cam 721, innermost upper front contact of relay 317 to ground at the upper left contact of cam 727.

A test is now made to determine if the ground placed on the tip and ring conductors of the calling line at the substation 100 has been removed as it should be when the calling subscriber restores his receiver to the switchhook. With sequence switch 700 in position 16, a circuit is established from battery, lower winding of relay 306, inner left front contact of relay 311, lower right contact of cam 738, to ground at the lower left contact of cam 708. Relay 306 energizes extending its operating ground from cam 708 over its inner lower front contact to the left winding of relay 309 which relay operates. At its outer right front contact relay 309 closes an obvious holding circuit through the upper winding of relay 306, and its inner left contact, closes a locking circuit for both itself and relay 309, extending through the left normal contacts of relay 314 and the inner left normal contacts of relay 302, the right contacts of cam 706, to ground over commutator segment 312 and brush 313. Relay 309 closes a circuit for relay 707 extending from battery, through its winding, the next to outer right front contact of relay 309, the upper contacts of cam 706, to ground over segment 312 and brush 313 as soon as the sequence switch 700 reaches position 16. Relay 309 at its inner left and right contacts also connects the winding of relay 308 to the tip and ring brushes 334 and 331 of the line finder and

thence to the tip and ring conductors of the calling line. Relay 308 should not operate at this time.

Relay 306 upon energizing connects ground
5 from the lower right contact of cam 705, conductor 725, inner upper contact of relay 306, conductor 724, over the lower contact of interrupter 723, to battery through the right winding of relay 722. Relay 722 locks over
10 its inner right contact to ground over the circuit just traced, independently of the contact of interrupter 723, and when the interrupter closes its upper contact extends the ground on conductor 724 over the outer
15 right contact of relay 722 to battery, through the winding of relay 302. Relay 302 energizes opening the locking circuit of relays 309 and 306 which release in turn releasing relay 722. With relay 309 released, a circuit
20 is closed to advance sequence switch 700 to position 17 extending from battery, winding of magnet 700, the lower left contact of cam 713, the outer left back contact of relay 714, the inner right back contact of relay 309,
25 to ground at the upper right contact of cam 705. As the sequence switch enters position $16\frac{3}{4}$ the holding ground extending to the contact 328 of relay 317 is extended over the lower left contact of cam 742, the outer right
30 front contact of relay 311, the intermediate right front contact of relay 310 to battery through the right winding of relay 300. Relay 300 upon energizing extends this operating ground over its right contact to
35 battery, through the left winding of relay 301, causing relay 301 to energize. At its outer right back contact relay 300 disconnects battery through resistance 323 from the sleeve conductor 112 of the subscriber's
40 line thereby releasing the cut-off relay 102, and at its outer right front contact connects the sleeve multiple of the calling line through the winding of relay 337 to ground at the upper left contact of cam 727 so that
45 should a final selector test the multiples of the calling line at this time, the relay 337 will be operated to open the message registering circuit which, as will hereinafter be explained, extends through the back contacts
50 of this relay. False registration is thus prevented. Relay 102 upon deenergizing connects the message register 105 assigned to the calling substation 100 over the right back contact of relay 102 and the inner right back
55 contact of relay 101 to conductor 114.

When the sequence switch 700 left position 16 relay 707 released. With relay 301 operated a circuit is now closed to operate relay 615 extending from battery, winding
60 of relay 615, conductor 620, outer left contact of relay 301, conductor 621, outer left front contact of relay 609, conductor 703, upper contacts of cam 702, upper contacts of cam 710, outer left back contact of relay
65 707, contact of interrupter 735, upper con-

tacts of cam 726, to ground at the upper right contact of cam 727. Relay 615 upon energizing also closes an obvious circuit for relay 607 which also energizes.

A circuit is now closed to advance the re- 70
cording switch 600 to position 7 extending from battery, winding of magnet 625, inner left front contact of relay 607, conductor 623, brush 603 in position 6, right front contact of relay 615, to ground at the lower 75
contact of interrupter 613. With the recording switch in position 7 a circuit for operating the calling subscriber's message register 105 may be traced from ground through the winding of message register 80
105, right back contact of cut-off relay 102, right back contact of relay 101, conductor 114, terminal 380, brush 381, conductor 624, brush 605, in position 7, conductor 626, right front contact of relay 607, conductor 85
627, back contact of relay 337, outer left front contact of charging relay 335, resistance 339 to battery. From position 7 switch 600 is advanced into position 10 over a circuit extending from battery, winding of 90
magnet 625, left front contact of relay 615, brush 603 and strapped terminals 7, 8 and 9, outer right front contact of relay 615 to ground at the lower contact of interrupter 613. As the brush 605 passes position 9 the 95
circuit previously traced through the message register is again closed operating the register a second time. Since relay 615 is now operated, the circuit extending from magnet 625 over its interrupter contacts, the 100
inner back contact of relay 615, No. 10 terminal, and brush 603, right back contact of relay 615, to ground at the inner left front contact of relay 609, is open at the contacts
of relay 615, and the recording switch is 105
held in position 10, and no further charging takes place.

To prevent the subscriber at substation 100 from interfering with the operation of the message register 105 during registration 110
through the operation of line relay 101, since at this time the cut-off relay 102 is deenergized, the line relay 101 is shunted down in a circuit extending from battery through resistance 340, left contact of relay 310, outer 115
left front contact of relay 300, brush 331, terminal 332, conductor 116, thence to the inner left back contact of relay 102. It is thus not possible for the subscriber to operate line relay 101 at this time. 120

With relay 607 operated a circuit is closed from battery, winding of relay 302, conductor 608, outer left front contact of relay 607, brush 603 in position 10, outer 125
right front contact of relay 615, to ground at the lower contact of interrupter 613. Relay 302 energizes, advancing sequence switch 700 into position 18 over a circuit extending from battery, winding of magnet 700, upper left contact of cam 718, outer right front con- 130

tact of relay 302 to ground at the upper left contact of cam 705. As soon as the sequence switch advances out of position 17, relays 607, 609, 615, 300, 301, 310, 311 and 335 re-

lease.

With the sequence switch 700 in position 18 a circuit is established for the down drive magnet 769 of the district selector, extending from battery through the winding of magnet 769, upper right and lower left contacts of cam 715 to ground over the lower contacts of cam 708. When the district selector shaft reaches its normal position, brush 743 engages commutator segment 744 establishing a circuit extending from ground at the upper right contact of cam 727, brush 743, segment 744, conductor 745, the inner right back contact of relay 609, brush 602 and the strapped terminals of its bank, the interrupter contacts and winding of stepping magnet 625 to battery. The recording switch 600 restores to normal by this circuit. With the switch 600 in normal position, ground on conductor 745 is transferred over brush 602 and its normal terminal, over brush 652 and the strapped terminals of its bank through the interrupter contacts and winding of stepping magnet 655 of the timing switch, restoring it to normal. All apparatus of the register controlling circuit of Fig. 6 is now in normal position.

When the timing switch 650 reaches normal, the ground on conductor 745 is transferred over brushes 603 and 652, both in normal position, conductor 628, the lower right contact of cam 717 to battery through the sequence switch magnet 700. The sequence switch advances into position 1 and the line finder is restored in the well-known manner.

Should the called subscriber hang up at any time during the conversation the timing switch 650 will stop upon again reaching its normal position, since the circuit previously traced for advancing it out of normal position to start a new timing cycle is dependent on contacts of relay 729 which relay is deenergized when the called subscriber hangs up.

In the foregoing description it has been assumed that the conversation lasted but 10 minutes requiring two charges. It will now be assumed that the conversation lasted 25 minutes or the limit for which the circuit is arranged to charge. As before described during two revolutions of the timing switch 650 the recording switch has been advanced to position 6. At this time relay 609 is energized but since the conversation is still continuing the relays 607 and 615 have not yet energized. As the timing switch rotates through a third revolution the circuit of magnet 625 of the recording switch is closed over brush 653 as it passes position 3, No. 6 terminal and brush 603,

the right back contact of relay 615 to ground at the inner left contact of relay 609, advancing the recording switch to position 7. From position 7 the recording switch advances automatically into position 10 over a circuit extending through the winding and interrupter contacts of magnet 625, the outer left back contact of relay 615, strapped terminals 7, 8 and 9 and brush 603 cooperating therewith, the right back contact of relay 615 to ground at the inner left contact of relay 609. From position 10 switch 600 is again advanced into position 11 over a circuit extending from battery, winding and interrupter contacts of magnet 625, the inner left contact of relay 615, the No. 10 terminal and brush 603 of switch 600 to ground at relay 609.

During the fourth revolution of timing switch 650 the circuit previously traced for advancing switch 600 out of position 6 is closed, advancing the recording switch into position 12 from which position it automatically advances as previously described into position 18. During the fifth revolution of timing switch 650 the circuit previously traced for advancing switch 600 out of position 6 is again closed, advancing the recording switch into position 19 from which position it automatically advances as previously described into normal position 1 and from position 1 into position 4 of a second revolution. The circuit for advancing it in its second revolution from position 1 into position 4 may be traced from battery, winding and interrupter contacts of magnet 625, the outer left back contact of relay 615, the strapped terminals 1 to 3 and brush 604 of switch 600, the right back contact of relay 615 to ground at the inner left contact of relay 609. In this connection it is to be noted that the brushes of the recording switch 600 are paired, brushes 601 and 602, 603 and 604, and 605 and 606 being paired and the brushes of each pair being staggered 180° from each other on the switch shaft. By thus arranging the brushes the recording switch is provided with 44 effective terminals without enlarging the size of the individual terminal banks.

When the recording switch reaches position 4 of its second revolution it is advanced into position 5 over a circuit extending from battery through the winding and interrupter contacts of magnet 625, the inner left back contact of relay 615, the No. 4 terminal and brush 604, the right back contact of relay 615 to ground at the inner left contact of relay 609. When the recording switch reaches position 5 it does not advance further because the circuit extending from the No. 5 terminal with which brush 604 now engages, is open at the inner left contact of relay 607 and therefore no circuit for the stepping magnet 625 is completed. The

timing switch, however, continues to rotate through successive cycles until the conversation is terminated but without further advancing the recording switch.

5 When the calling subscriber hangs up to terminate the conversation the district selector circuit functions as previously described, relays 607 and 615 operate and the further advance of the timing switch is arrested.
 10 With relay 607 operated a circuit is closed for advancing the recording switch 600 out of position 5 into position 6 extending from battery, winding of magnet 625, inner left front contact of relay 607, conductor 629,
 15 No. 5 terminal and brush 604, outer right front contact of relay 615, to ground at the lower contact of interrupter 613. From position 6 switch 600 is advanced into position 15 under the control of interrupter 613
 20 over a circuit extending from battery, winding of magnet 625, left front contact of relay 615, strapped terminals associated with brush 604, brush 604, outer right front contact of relay 615 to ground at the lower con-
 25 tact of interrupter 613. As the switch 600 passes through positions 6 to 14 a charging circuit is closed extending from message register 105, the left back contact of cut-off relay 102, the inner right back contact of
 30 relay 101, conductor 114, terminal 380, brush 381, conductor 624, strapped terminals associated with brush 606, brush 606, conductor 626, right front contact of relay 607, conductor 627, back contact of relay 337,
 35 outer left front contact of relay 335, resistance 339 to battery. This circuit being closed by brush 606 as it passes through positions 6, 8, 10, 12 and 14, five charges are registered for the call.

40 Charges for calls lasting for one, three or four conversational periods of five minutes each are charged in substantially the same manner as previously described and it is believed that a detailed description of the man-
 45 ner in which the recording switch functions for such calls is unnecessary. For a five minute call, however, switch 600 is advanced to position 3 during conversation, and after the call is terminated, advances to position 5,
 50 and the charging path is closed but once over brush 605 as it passes position 4. For a fifteen minute conversation the brush 600 is advanced to position 11 during the conversation and upon the termination of conversa-
 55 tion advances to position 17, closing the charging path three times as brush 605 passes through positions 12, 14 and 16. For a twenty minute call switch 600 is advanced to position 18 during the conversation and
 60 rotates into position 4 of its second revolution upon the termination of the conversation, the brush 605 closing the register circuit twice as it passes through positions 19 and 21 of the first revolution of the record-
 65 ing switch, and the brush 606 closing the

register circuit twice more as it passes through positions 1 and 3 of the second revolution.

Charge call initiated by subscriber 150.

70 Had the party at substation 150 initiated the call the circuits would have functioned in the manner above described except that when relay 308 tested with the sequence switch 700 in positions $10\frac{3}{4}$ to $11\frac{1}{4}$, no
 75 ground would have been found and relays 308 and 310 would not have operated, and after the release of relays 306, 309 and 722 sequence switch 700 would advance to posi-
 80 tion 17. Under this condition as sequence switch 700 enters position $16\frac{3}{4}$ to 17 the locking circuit of relay 317 is extended from the upper winding of relay 317, the lower left contact of cam 742, the outer right front
 85 contact of relay 311, the middle right back contact of relay 310 to battery through the left winding of relay 301. The cut-off relay 102 is not released since relay 300 is not
 90 operated. Relay 301 operates in turn operating relays 607 and 615 to start charging operations. From this point the charging takes place as previously described except
 95 that the charging circuit extends from ground through the message register 106 assigned to the substation 150, the right front contact of relay 102, the inner right back
 100 contact of relay 101, conductor 114, terminal 380, brush 381, conductor 624, thence as previously described through either brush 605 or 606 of the recording switch to resistance 339 and battery.

No charge call.

105 It may be desirable to give free service to subscribers when they call into certain zones of the exchange area. For such calls the district sequence switch 700 is set into position 13 for talking. Under this condition the charge relay 335 will operate when the tim-
 110 ing switch first advances through position 2 and will lock as previously described over the lower left contact of cam 720. During the conversation the timing switch advances as previously described setting the recording switch to record the number of unit periods
 115 of conversation. When the calling subscriber hangs up to terminate the conversation, however, the district sequence switch 700 advances out of position 13 into position 16 and in so doing opens the locking circuit of
 120 charging relay 335 which deenergizes in turn unlocking relays 311, 301, 607, 609 and 615.

125 Since relays 335 and 311 are now deenergized, as the sequence switch 700 passes through positions $14\frac{3}{4}$ to $15\frac{1}{4}$ no circuit is established for relay 306, and therefore relays 308 and 309 do not function to test the calling line. A circuit is therefore effective to advance sequence switch 700 directly into
 130 position 17, this circuit extending from bat-

tery, winding of magnet 700, the lower left contact of cam 713, the outer left back contact of relay 714, the right back contact of relay 309, to ground at the upper right contact of cam 705. In position 17, relay 302 energizes over a circuit extending through its winding, the right back contact of relay 311, the lower left contact of cam 742, the inner upper front contact of relay 317 to ground at the upper left contact of cam 727. Relay 302 upon energizing advances the sequence switch 700 into position 18 as previously described. In position 18 the district selector restores and upon reaching its normal position connects ground to conductor 745 as previously described returning both switches 600 and 650 to normal. The other operated apparatus restores as previously described. However, since the charging relay 335 and relay 607 are not energized at the time the calling subscriber restores his receiver to the switchhook and message registration would normally be effected, no charging path is completed to the calling subscriber's message register and therefore no charge is made for the call.

What is claimed is:

1. In a telephone system, a calling line, a called line, means for extending the calling line to said called line, a call charging device for said calling line, a recording switch, means operative upon the response of the called subscriber and until the calling subscriber hangs up for periodically advancing said switch, means operative when the calling subscriber hangs up to advance said switch to normal, and a circuit controlled by said switch in its advance to normal for operating said charging device a number of times which is a measure of the elapsed period of conversation.

2. In a telephone exchange system, a calling line, a called line means for extending the calling line to said called line, a call charging device for said calling line, a recording switch, means operative upon the response of the called subscriber and until the calling subscriber hangs up for advancing said switch as a measure of the elapsed predetermined unit periods of conversation, means operative when the calling subscriber hangs up to advance said switch to normal, and a circuit controlled by said switch in its advance to normal for operating said charging device once for each elapsed unit period of conversation.

3. In a telephone exchange system, a calling line, a called line, means for extending the calling line to said called line, a call charging device for said calling line, a recording switch, means operated upon the response of the called subscriber for advancing said switch, means for thereafter successively measuring off predetermined unit periods of conversation until the calling sub-

scriber hangs up, means for further advancing said switch at the commencement of each unit period, means operated when the calling subscriber hangs up to advance said switch to normal, and a circuit controlled by said switch in its advance to normal for operating said charging device once for each elapsed unit period of conversation.

4. In a telephone exchange system, a calling line, a called line, means for extending the calling line to said called line, a call charging device for said calling line, a recording switch having a plurality of stopping positions, means operated upon the response of the called subscriber for advancing said switch out of its normal position into its first stopping position, means for thereafter successively measuring off predetermined unit periods of conversation until the calling subscriber hangs up, means for advancing said switch to successive stopping positions at the commencement of each unit period, means operated when the calling subscriber hangs up to advance said switch to normal, and a circuit controlled by said switch in its advance to normal for operating said charging device once for each elapsed unit period of conversation.

5. In a telephone exchange system, a calling line, a called line, means for extending the calling line to said called line, a call charging device for said calling line, a recording switch having a plurality of stopping positions, means operated upon the response of the called subscriber for advancing said switch out of its normal position into its first stopping position, means for thereupon automatically advancing said switch into its first stopping position, means for successively measuring off predetermined unit periods of conversation until the calling subscriber hangs up, means for advancing said switch out of successive stopping positions at the commencement of each unit period whereupon said switch is automatically advanced to its next stopping position, means operated when the calling subscriber hangs up to advance said switch to normal, and a circuit controlled by said switch in its advance to normal for operating said charging device once for each position in which said switch has been arrested during the conversational period.

6. In a telephone exchange system, a calling line, a called line, means for extending the calling line to said called line, a call charging device for said calling line, a recording switch having a plurality of stopping positions, means operated upon the response of the called subscriber for advancing said switch out of its normal position into its first stopping position, means for thereafter successively measuring off predetermined unit periods of conversation until the calling subscriber hangs up, means for

advancing said switch to successive stopping positions at the commencement of each unit period, means operated when the calling subscriber hangs up to further advance said switch through one or more cycles to normal, and a circuit controlled by said switch in its advance to normal for operating said charging device once for each position in which said switch has been arrested during the conversational period.

7. In a telephone exchange system, a calling line, a called line, means for extending the calling line to said called line, a call charging device for said calling line, a timing switch, a recording switch, means operated upon the response of the called subscriber to start said timing switch, means for continuing the advance of said timing switch through successive cycles until the calling subscriber hangs up, each cycle of said timing switch measuring a predetermined conversational period, means controlled by said timing switch during each cycle for advancing said recording switch, means operative when said calling subscriber hangs up to advance said recording switch to normal, and a circuit controlled by said recording switch in its advance to normal for operating said charging device.

8. In a telephone exchange system, a calling line, a called line, means for extending the calling line to said called line, a call charging device for said calling line, a recording switch having two sets of terminal banks arranged in pairs and a brush for each bank, the brushes associated with paired banks being disposed 180° apart on the switch shaft, one set of said banks and brushes being normally effective, means operative upon the response of the called subscriber and until the calling subscriber hangs up for periodically advancing said switch, means operative upon a predetermined advance of said switch to render the first set of banks and brushes ineffective and to render the second set of brushes effective, means operative when the calling subscriber hangs up to advance said switch to normal and a circuit controlled by said switch when it is advanced to normal for operating said charging device a number of times which is a measure of the elapsed period of conversation.

9. In a telephone exchange system, a calling line, a called line, selector switches for extending the calling line to said called line, means for selectively operating said switches, a call charging device for said calling line, a recording switch, means operative upon the response of the called subscriber and until the calling subscriber hangs up for periodically advancing said switch, means operative when the calling subscriber hangs up to advance said switch to normal, and

a circuit controlled by said switch in its advance to normal for operating said charging device a number of times which is a measure of the elapsed period of conversation.

10. In a telephone exchange system, a calling line, a called line, selector switches for extending the calling line to said called line, means for selectively operating said switches, a call charging device for said calling line, a recording switch, means operative upon the response of the called subscriber and until the calling subscriber hangs up for advancing said switch as a measure of the elapsed predetermined unit periods of conversation, means operative when the calling subscriber hangs up to advance said switch to normal, and a circuit controlled by said switch in its advance to normal for operating said charging device once for each elapsed period of conversation.

11. In a telephone exchange system, a calling line, a called line, selector switches for extending the calling line to said called line, means for selectively operating said switches, a call charging device for said calling line, a recording switch, means operated upon the response of the called subscriber for advancing said switch, means for thereafter successively measuring off predetermined unit periods of conversation until the calling subscriber hangs up, means for further advancing said switch at the commencement of each unit period, means operated when the calling subscriber hangs up to advance said switch to normal, and a circuit controlled by said switch in its advance to normal for operating said charging device once for each elapsed period of conversation.

12. In a telephone exchange system, a calling line, a called line, selector switches for extending the calling line to said called line, means for selectively operating said switches, a call charging device for said calling line, a timing switch, a recording switch, means operative upon the response of the called subscriber to start said timing switch, means for continuing the advance of said timing switch through successive cycles until the calling subscriber hangs up, each cycle of said timing switch measuring a predetermined conversational period, means controlled by said timing switch during each cycle for advancing said recording switch, means operative when said calling subscriber hangs up to advance said recording switch to normal, and a circuit controlled by said recording switch in its advance to normal for operating said charging device.

In testimony whereof, I have signed my name to this specification this 10th day of November, 1927.

WILLIAM T. HAINES.