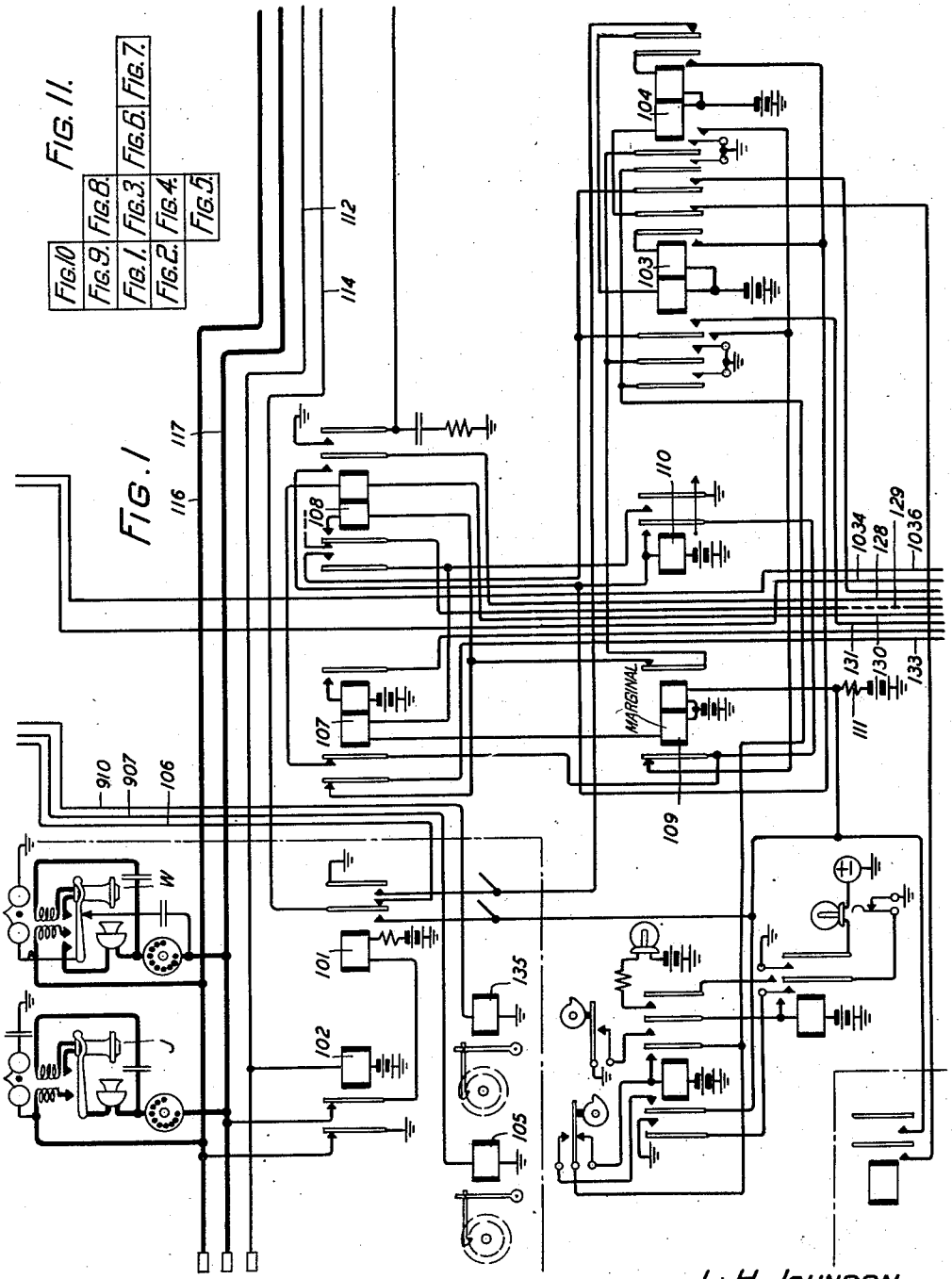
May 24, 1932. L. H. JOHNSON ET AL 1,859,924

CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed June 28, 1930 · 10 Sheets-Sheet 1



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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed June 28, 1930 10 Sheets-Sheet 2

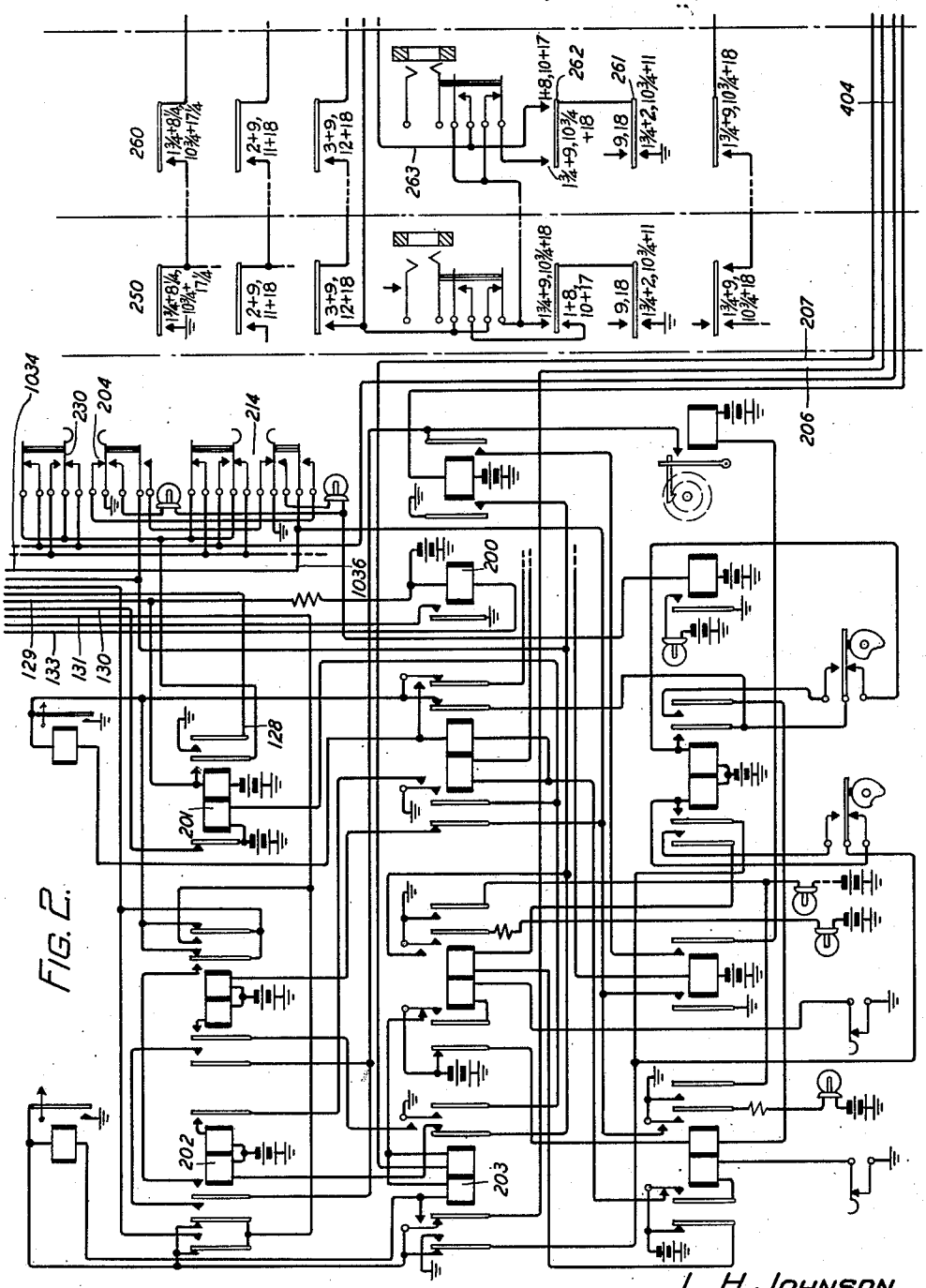

FIG. 2.

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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

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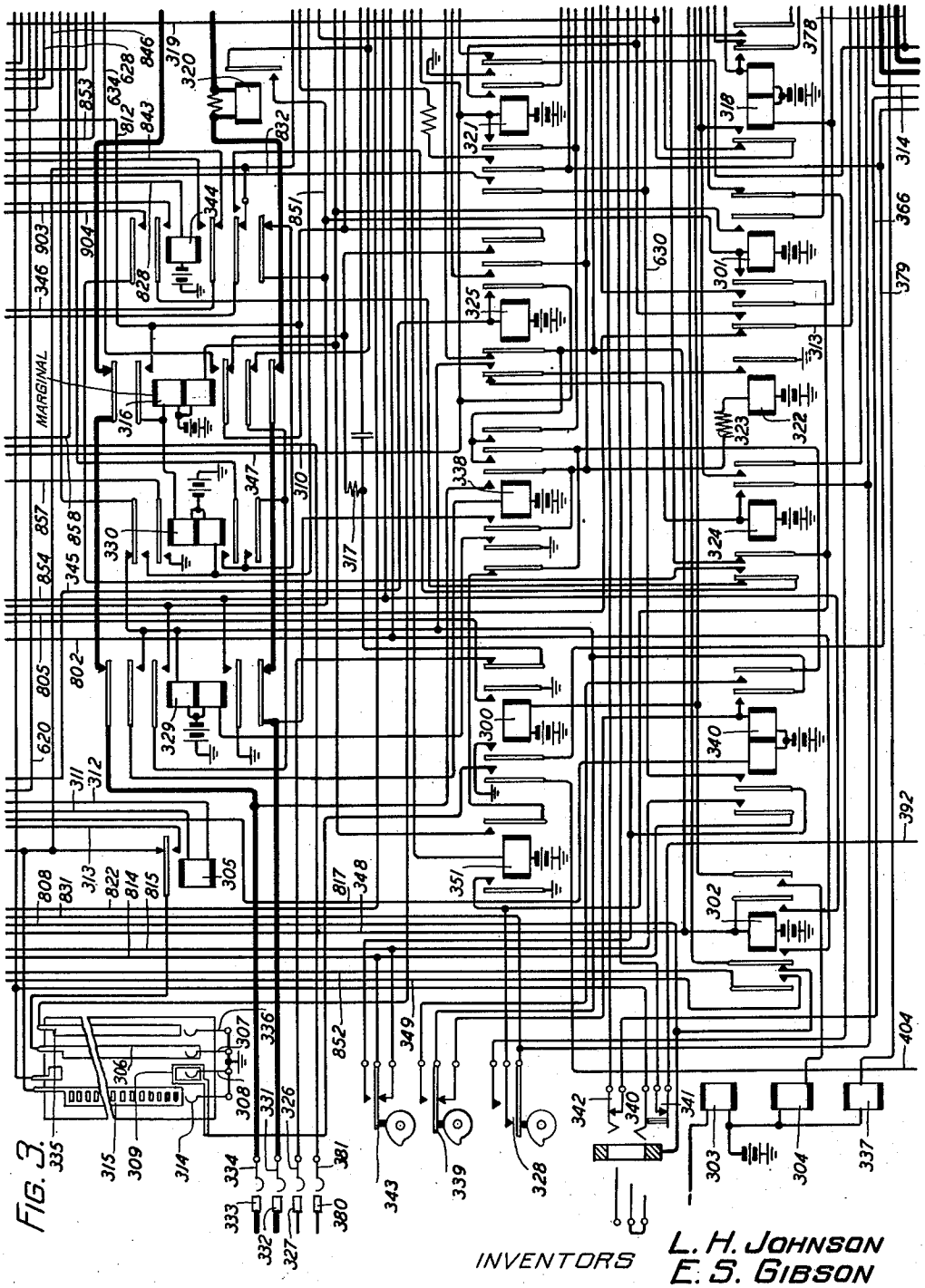

FIG. 3.

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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed June 28, 1930 10 Sheets-Sheet 4

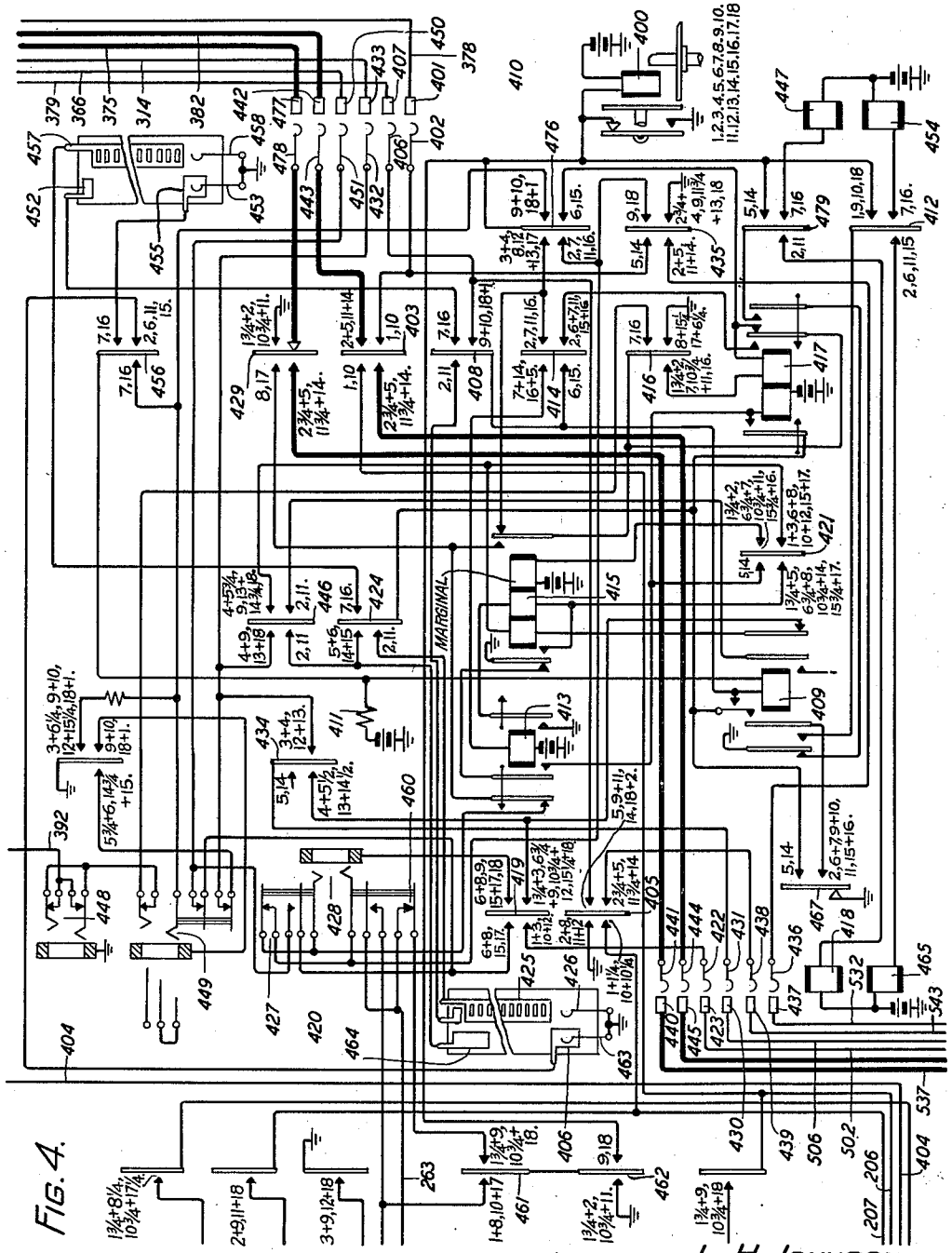

FIG. 4.

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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed June 28, 1930 10 Sheets-Sheet 5

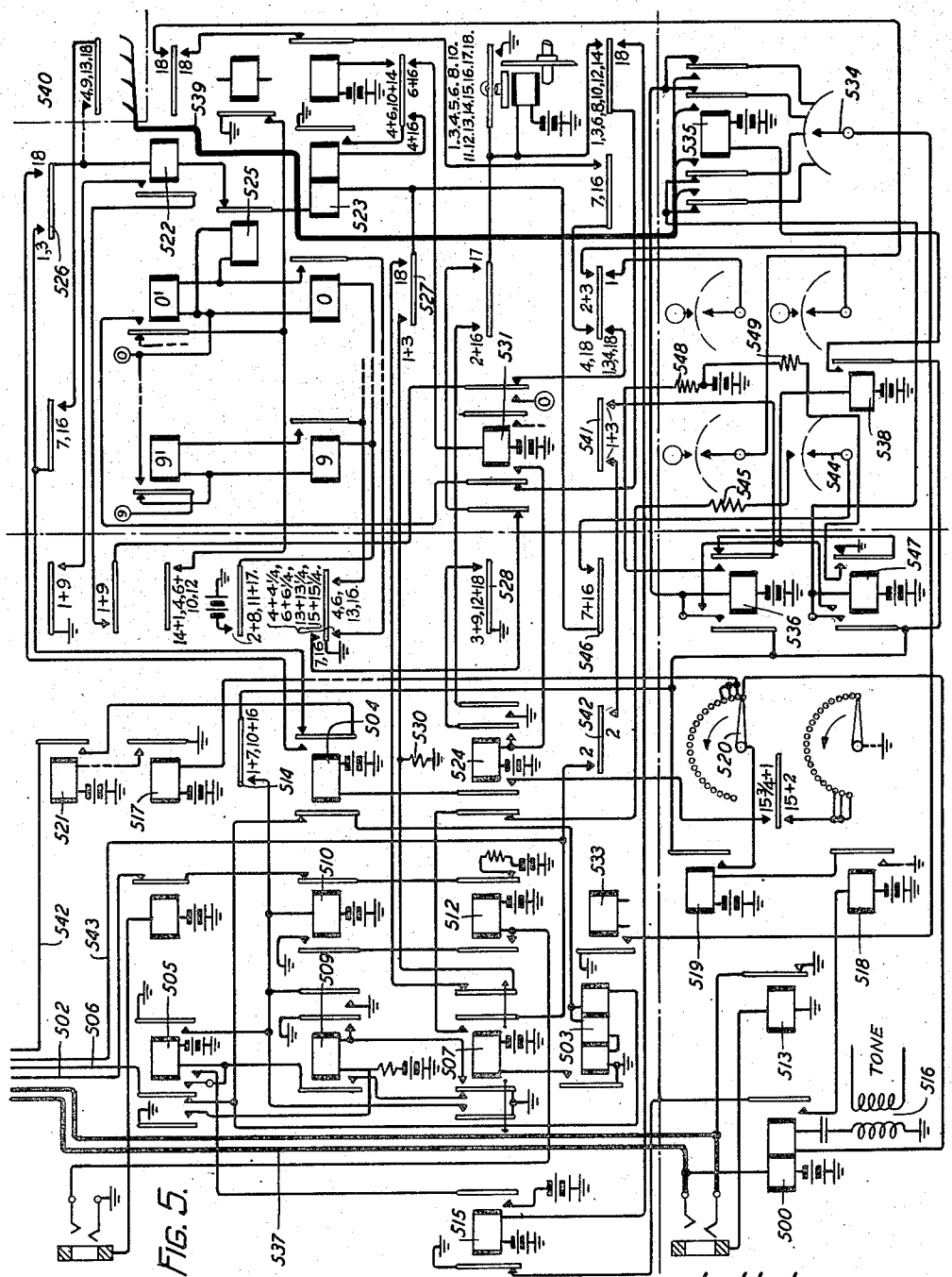

FIG. 5.

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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

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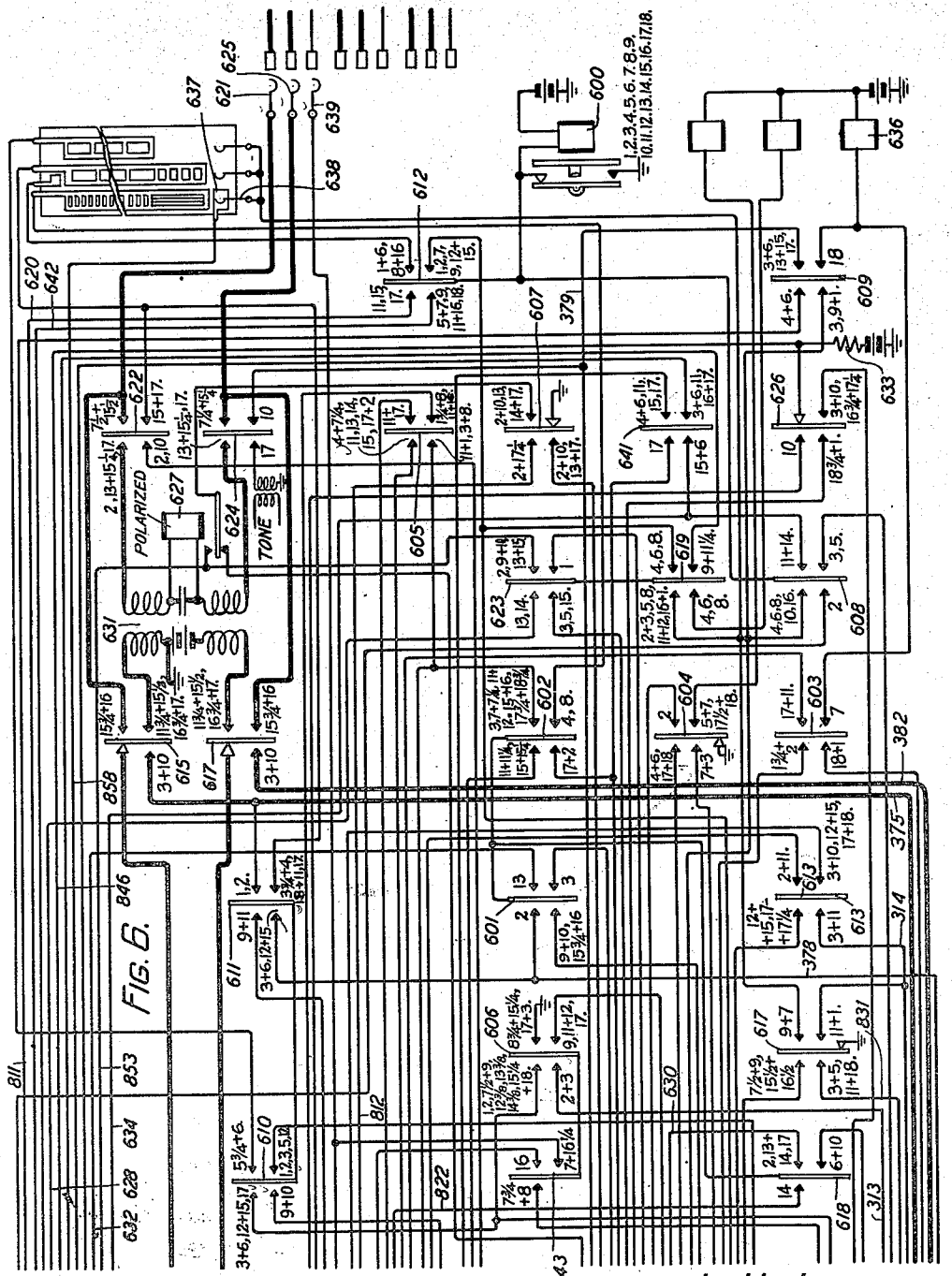

FIG. 6.

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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed June 28, 1930 10 Sheets-Sheet 7

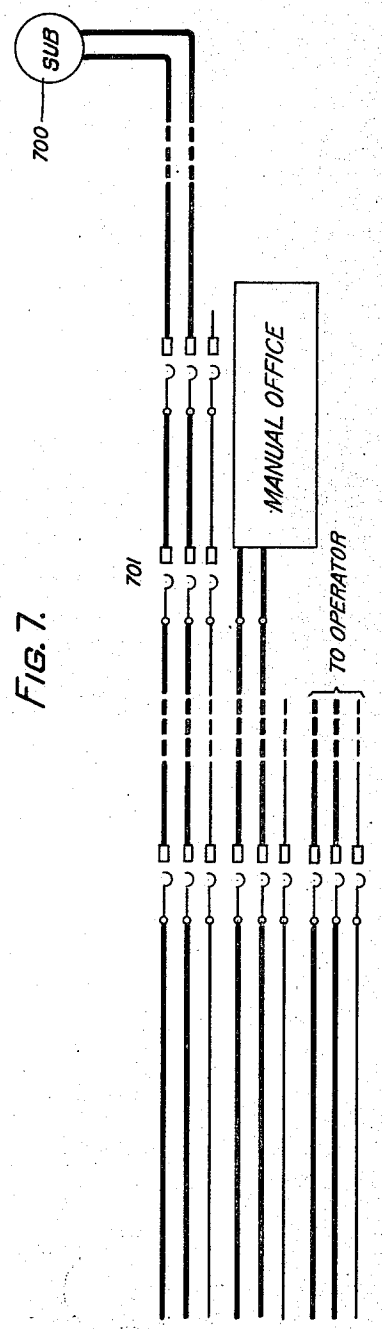

FIG. 7.

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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

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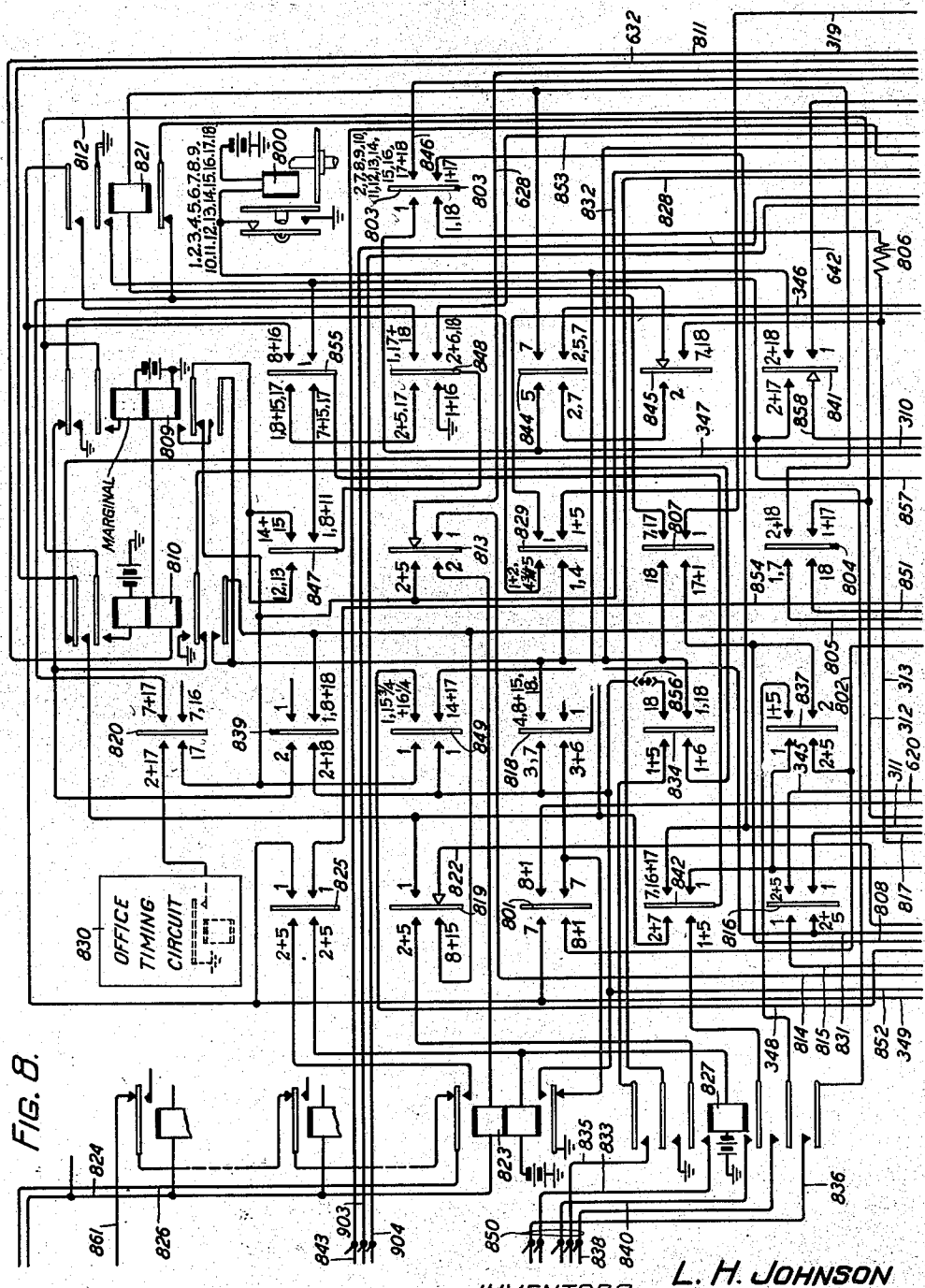

FIG. 8.

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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed June 28, 1930 10 Sheets-Sheet 9

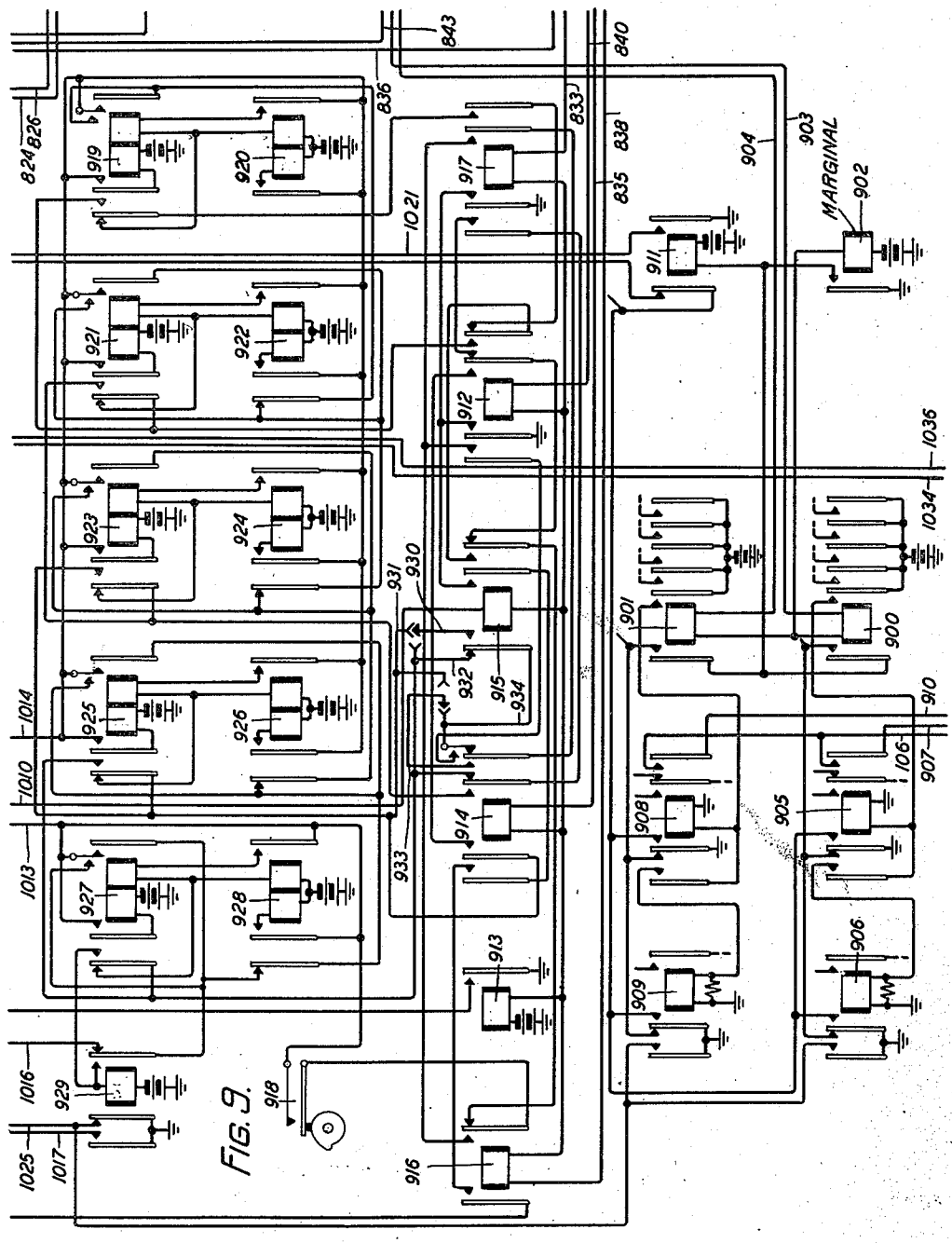

FIG. 9.

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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed June 28, 1930 10 Sheets-Sheet 10

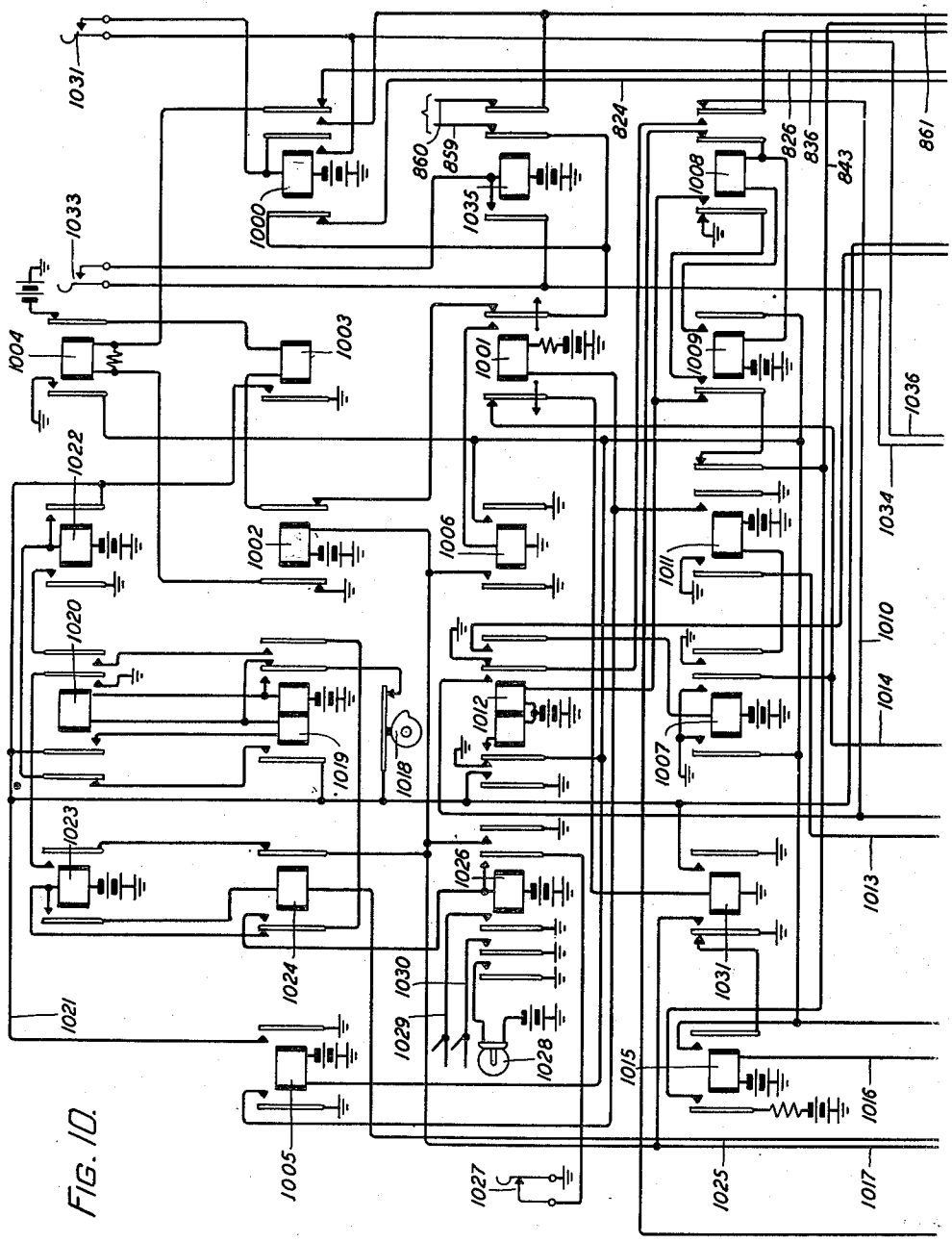

FIG. 10.

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Patented May 24, 1932 1,859,924

UNITED STATES PATENT OFFICE

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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Application filed June 28, 1930. Serial No. 464,442.

This invention relates to dial telephone systems and more particularly to metering calls on multi-party telephone lines. The object of the invention is the attainment of more equitable compensation for the use of telephone facilities.

In large exchange areas having several offices some of which may be located at very distant points in the area, it is desirable that means be provided whereby a calling subscriber may be charged differently for calls to offices which are most remotely located from the office in which the calling line terminates, than for calls to offices which are not so remotely located since remotely located offices must be reached over long interoffice trunks which are expensive to install and maintain and it is not equitable to the operating company to provide service to all points in the exchange area at the same basic rate. Furthermore, it is not equitable to the operating company that for a basic rate a subscriber shall be enabled to hold an established connection indefinitely.

Both automatic charging in accordance with the zone of the exchange area into which a connection has been extended and in accordance with the elapsed conversational period have been heretofore accomplished. The charging of calls on multi-party lines through the operation of a meter control device common to a group of calling lines has been effected as disclosed in Patent No. 1,778,309, granted Oct. 14, 1930 to W. W. Carpenter and L. H. Johnson.

In accordance with the present invention one embodiment of which is disclosed herein by way of illustration, provision has been made for charging calls on multi-party lines by means of a common meter control device of the general character disclosed in the aforementioned application in accordance with the zone of the exchange area into which a call has been extended and in accordance with the elapsed time during which the connection is held for conversation. While the invention has been illustrated in connection with subscribers' lines having but two party stations, the invention is equally applicable to lines having a greater number of stations by the utilization of meter selector mechanism of the specific character disclosed in the aforementioned application.

The embodiment of the invention illustrated herein discloses subscribers' lines each having two party stations thereon and a message register associated with each line at the central office for each party station on the line. Each line terminates in the bank terminals of a group of line finders and has a single message register terminal over which either party register may be controlled. Each line finder of the group which has access to a group of 400 subscribers' lines is paired with a district selector by a link circuit. Individual to each line finder-district link circuit there is provided a timing switch circuit for measuring a predetermined initial period of conversation and for measuring overtime periods if the conversation between the calling line and a called line is continued.

Associated with the timing switch circuit are zone recording relays which are selectively operated from the common register sender in accordance with the zone of the exchange area into which a connection is extended. The sequence switch of the district selector also assumes different positions dependent upon the zone into which the connection is established and cooperates with the zone recording relays to establish in the timing switch circuit a record of which of six zones the called line terminates in.

Common to all of the line finder-district links which serve a group of 400 lines, a message register connector circuit is provided. This common circuit is equipped with a plurality of sets of multi-contact relays, each set serving to connect with all of the message registers of corresponding party stations. Thus, for example, one set of relays is arranged to connect with all of the registers of the J stations and the other set of relays is arranged to connect with all of the registers of the W stations of the group of 400 lines. Associated with the common connector circuit is a plurality of party designating relays which are selectively operated from the line finder-district link for operating the multi-contact relays in accordance with the test

made by the link for determining which party on a calling line has initiated a particular call. The common connector circuit is also provided with a group of zone recording relays to which the zone record is transferred from the timing switch circuit and which control, through an impulsing device, the application of one or more impulses to the party line message register selected. These impulses are applied through the line finder-district link over a line finder brush to the message register terminal of the calling line.

Briefly, the invention functions in the following manner: After the calling subscriber's line has been extended to the line finder-district link by the line finder, a test is made to determine which party on the line has initiated the call and a record of such test is made in the link. After the calling line has become extended to the called line and the called subscriber has answered, the timing switch functions to cause the association of the common message register connector circuit with the link and to transfer the zone record which has been set up in the timing switch circuit through the operation of the sender and district selector sequence switch to the zone recording relays of the common circuit. The party designation is at this time also transferred from the link to the common circuit.

The common register connector circuit thereupon proceeds through the operation of its multi-contact relays to connect with the terminals of all message registers of the group of 400 lines in which the calling line is located corresponding to the party on the calling line who has initiated the call and to establish a message register operating circuit extending from operating battery through the link circuit over a brush and terminal of the line finder to the other terminal of the message register of the calling line party. Since the line finder can connect with but one register terminal at a time, an operating circuit for only the register of the calling line substation is effective.

In accordance with the zone record set up in the common circuit, the selected message register is variably operated to charge the calling party for the initial period of conversation. As soon as this charging is completed the timing switch is advanced to dismiss the common circuit and under the control of a timing interrupter to measure off a period of time prescribed for the initial period of conversation, which period may differ in accordance with the zone of the exchange area into which the connection has been extended. If the conversation continues at the end of this period, the timing switch is caused to start upon a second cycle, again seizing the common register connector circuit and causing the operation of the calling party register to charge for an overtime period of conversation. As soon as this charging is completed the timing switch is advanced to dismiss the common circuit and to measure off a second period for conversation. In this manner the timing switch advances through successive cycles until the connection is released. In the embodiment of the invention illustrated, the overtime periods measured vary in accordance with the zone in which the called line terminates and differ from the initial period measured on the same call.

A clearer conception of the scope and purpose of the invention will be obtained from a consideration of the following description in connection with the attached drawings in which;

Fig. 1 shows a calling subscriber's line having two party substations thereon together with certain relays common to groups of calling lines;

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

Figs. 3 and 6 taken together show a line finder-district link circuit, Fig. 3 showing the line finder and Fig. 6 the district selector;

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

Fig. 5 shows a skeletonized disclosure of a register sender;

Fig. 7 shows in schematic form selectors for completing a connection to an automatic subscriber's line, to a manual office or to an operator's position;

Fig. 8 shows a timing switch individual to the line finder-district selector link of Figs. 3 and 6 for measuring the initial and overtime periods of conversation allotted to a calling subscriber for calls to different zones of the exchange area, and for seizing the common message register connector circuit;

Figs. 9 and 10 taken together show a common message register connector circuit for connecting the message register of a calling party line substation into an operating circuit and for controlling the manner in which the connected message register shall be operated for calls to different zones;

Fig. 11 shows the manner in which Figs. 1 to 10 should be arranged to completely disclose the invention.

The invention has been embodied in a disclosure which is similar to that of U. S. Patent 1,567,072, granted to W. H. Matthies, December 29, 1925, both the present disclosure and that of the Matthies patent showing a skeletonized sender substantially the same as that disclosed in the more complete disclosure of U. S. Patent 1,589,402, granted to O. H. Kopp, June 22, 1926, and reference to the Kopp patent is made for operations not completely described herein.

As disclosed in the above mentioned patents a plurality of link circuits is 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 an allotted position 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 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.

Establishment of a connection from substation J

It will first be assumed that the subscriber at substation J first initiates a call for line 700 in zone 5 of the exchange area for which he is to be charged five times for the first three minutes of conversation and once for each one minute overtime period of conversation. When the subscriber at substation J removes his receiver from the switchhook a circuit is closed from battery through the winding of relay 101, back contact of relay 102, over the subscriber's line to ground at the outer contact of relay 102. Relay 101 in operating closes a circuit from battery, winding of relay 103, right back contact of relay 104 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 marginal relay 109 in parallel, inner front contact of relay 101 to conductor 114, to identify the calling line to the line finder. Relay 103 in operating closes a circuit from battery over the back contact of relay 201, conductor 130, right winding of relay 108, inner back contact of relay 107, back contacts of relay 109, middle left contact of relay 103 to ground.

Relay 108 operates in this circuit and closes 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, inner left front contact and left winding of relay 108, the right back contact of relay 109 to ground at the middle left front contact of relay 103. Relay 108 prepares a circuit from ground at its outer right contact through the winding of trip magnet 303 of 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 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, the left back contact of relay 109 to ground at the middle left front contact of relay 103. Relay 110 closes a starting circuit for 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 600 in position 2. The operation of relay 110 will therefore close a circuit from ground at its outer right contact, outer left front contact of relay 108, inner left front contact of relay 103, conductor 131, left back contact of relay 202, inner left back contact of relay 203, conductor 206, upper left and lower right contacts of cam 403, brush 402 and terminal 401, conductor 378, upper left contact of cam 601, lower left contact of cam 602, winding of relay 302 to battery.

Relay 302, upon operating, closes a circuit from battery through the winding of updrive magnet 304 of the line finder, outer right contact of relay 302 and in parallel through the winding of relay 300, upper contacts of cam 603, inner left front contact of relay 302 to ground at the lower left contact of cam 604. Relay 302 also locks over its inner right front contact, the upper left and lower right contacts of cam 605, the back contact of relay 305 to ground over commutator segment 306 and brush 307. The line finder moves upwardly under the control of magnet 304 and since trip magnet 303 is operated, the proper set of brushes is tripped. The operation of relay 300 at its right back contact removes ground from the line finder brush 326 during hunting, and prepares a circuit which is closed as soon as commutator brush 308 engages segment 309 which extends from ground on brush 308, outer 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 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 the brush 308 leaves segment 309 the circuit of relay 201 is opened and that relay also releases. When line finder brush 381 makes contact with terminal 380 which is connected over conductor 114 to battery, a circuit is completed over conductor 310, the upper left and lower right contacts of cam 803, conductor 311, winding of relay 305, conductor 312, lower right and upper left contacts of cam 804, conductor 805, outer left back contact of relay 301, conductor 313 to ground over the lower left and upper right contacts of cam 606. Relay 305 operates in this circuit and closes a shunt around its

winding from ground over commutator brush 307 and segment 306, front contact of relay 305, conductor 313, resistance 806, lower contacts of cam 803, thence as traced through the winding of relay 305 to ground at cam 606. This shunt circuit 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 relay 110 which, in turn, opens the energizing circuit of relay 302. The operation of relay 305 also opens one locking circuit of relay 302 causing that relay to release as soon as the line finder brushes become centered on the terminals of the calling line and commutator brush 314 engages an insulating portion of centering segment 315. The release of relay 302 opens the circuit of updrive magnet 304 to arrest the hunting movement of the line finder and opens the circuit of relay 300.

At the time relay 300 operated it closed a circuit from ground at its inner left contact over conductor 379, terminal 407 and brush 406 of finder 410, lower 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 the switch 400 leaves position 1, relay 409 releases. In position 2 a circuit is closed from battery, through the winding of relay 413, the upper contacts of cam 414, right back contact of relay 415 to ground at the lower right 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, in operating, closes a circuit from battery through the winding of updrive magnet 418 of the sender finder 420, left contact of cam 479, outer right front contact of relay 417 to ground at the left back contact of relay 409. The sender finder moves upwardly under the 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, the upper right and lower left 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 its magnetic circuit so that it becomes quick to operate when the test circuit is later closed. The test circuit extends from brush 422, over the lower contacts of cam 419, the right back contact of relay 409, the left winding of relay 415, the lower 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. Relay 415, in operating, closes a locking circuit for itself from battery, through its right winding, upper right and lower left contacts of cam 421 to ground at the left front contact of relay 415. It also opens the circuit of relay 417 which releases to, in turn, release magnet 418 and bring the sender finder to rest on the terminals of the idle sender. The release of relay 417, in turn, releases relay 413. With relay 413 released and relay 415 operated, 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, left back contact of relay 413, right front contact of relay 415 to ground at the lower right contact of cam 416, advancing sequence switch 400 to position 3.

When the link circuit advanced into position 2 for hunting for an idle sender, a circuit was closed for relay 318 extending from battery, right winding of relay 318, lower right contact of cam 610, upper right contact of cam 611, conductor 375, terminal 477 and brush 478 of district finder 410 to ground at the upper right contact of cam 429. Relay 318 locks over its inner right front contact and the upper contacts of cam 606 to ground. A circuit is now established for advancing sequence switch 600 into position 3 which may be traced from battery through magnet 600, the lower right contact of cam 612, the left front contact of relay 318, conductor 319, lower contacts of cam 807, conductor 808, the left back contact of relay 302 to ground at the lower left contact of cam 604. As the sequence switch 600 advances from position 2 to 3, relay 318 releases. With sequence switch 600 in position 3, busy ground is applied to the sleeve conductor 112 of the calling line over line finder brush 326, right back contact of relay 300, resistance 317, inner lower back contact of relay 316 conductor 812 to ground at the upper left contact of cam 607. Cut-off relay 102 of the calling line operates over this circuit releasing line relay 101 which, in turn, removes battery from conductor 114, thereby releasing relay 305. With sequence switch 600 in position 3 a circuit is established from battery through the winding of relay 322, resistance 323, lower right contact of cam 601, upper right contact of cam 602, segment 335 and brush 336 to ground for testing the sensitivity of test relay 322. Relay 322 should operate at this time and upon operating establishes a circuit for relay 324 extending from battery through the winding of relay 324, outer left back contact of relay 325 to ground at the contact of relay 322. Relay 324 upon operating locks over its inner right

front contact to ground at the lower left contact of cam 617. If relay 322 does not operate the call is blocked and an alarm signal is given.

When sequence switch 400 reaches position 3 a circuit is closed from ground through the left and middle windings of relay 503, back contacts of relays 504 and 505, conductor 506, terminal 430, brush 431, right contact of cam 434, brush 432, terminal 433, conductor 314, lower left and upper right contacts of cam 613, assuming that the district selector sequence switch 600 has now advanced to position 3, through the winding of relay 351 to battery and in parallel over the lower contacts of cam 613 to battery through the lower winding of relay 316. Relay 316 is marginal and does not operate but relay 315 operates although ineffective at this time. Relay 503 operates and closes an obvious circuit for relay 507 which, in turn, closes a circuit for relay 509. Relay 509 operates relay 510.

As soon as sequence switch 400 arrived in position 2¾, it prepared a 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 contacts of cam 429, brush 478, terminal 477, conductor 375, left contact of cam 615, upper back contacts of relays 316 and 329, brush 334, terminal 333, conductor 116, through the subscriber's substation conductor 117, terminal 332, brush 331, outer lower back contacts of relays 329 and 316, winding of relay 320, left contacts of cam 617, conductor 382, terminal 442, brush 443, upper right and lower left contacts of cam 403, brush 444, 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, in turn, operating relay 519. A circuit is thereupon closed from the source of tone 516 through the right winding of relay 500, switch 520 in normal position, front contact of relay 519, contact of cam 514 to ground at the 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 by manipulating his dial.

When relay 510 operated it removed battery from conductor 502, releasing relay 415. With relay 415 released, 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 lower right contact of cam 416 for advancing sequence switch 400 into position 5. Sequence switch 400 remains in position 5 throughout the further operation of the sender. The calling subscriber now proceeds to dial the desired line number for setting the registers and translator of the sender in the well-known manner. After dialing the first digit the switch, the wiper of which is shown at 520, advances from normal closing a circuit extending from battery through the winding of relay 517, terminals and wiper 520, contacts of relay 519, contact of cam 514 to ground at the outer right contacts of cam 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 a manner described in the aforementioned patent to O. H. Kopp. When the translator assumes its setting, relay 533 operates and circuits are prepared over the translator arc 534, through a back contact of relay 535 for operating either relay 536 or relay 547 or neither of them dependent upon in which zone of the exchange the wanted line is located. For example, if a called number is dialed for either zone 0 or zone 1, neither relay 536 nor 547 will be operated. If a call is dialed for either zone 2 or zone 3, relay 536 will be operated and if the call is for either zone 4 or zone 5, relay 547 will be operated. It will be assumed that a call is for a subscriber's line terminating in the fifth zone and that therefore relay 547 is operated over a circuit extending from battery, winding of relay 547, back contact of relay 535, translator arc 534 to ground at the contact of relay 533. Relay 547 locks over its left front contact, the contact of cam 514 to ground at the outer right front contact of relay 509 and extends its locking ground to the winding of relay 538. Relay 538 upon operating establishes a circuit from ground at the outer right contact of relay 509 over the contact of cam 514, the contact of relay 538 to battery through the winding of relay 535. Relay 535 operates opening the initial energizing circuit of relay 547 and connecting the translator arc 534 over a 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. With relay 547 operated and relay 536 non-operated, a circuit is prepared extending from battery through low resistance 549, right front contact of relay 547, right back contact of relay 536, the contacts of cams 541 and 542, these cams being closed during the district brush selection positions of the sequence switches associated with the sender, conductor 543, terminal 439, brush 438, right contacts of cam 405, brush 406, terminal 407, conductor 379 to the upper right contact of cam 609. This circuit is completed as will be hereinafter described when the district sequence switch is advanced to position 4, through the lower windings of zone relays 809 and 810 of the timing circuit of Fig. 8 for indicating the fact that the subscriber has made a call to

a particular zone of the exchange, in the case assumed, the fifth zone. It may be noted at this time that due to the inclusion of the low resistance 549, both zone relays 809 and 810 will operate. Had relay 536 been operated, then battery through high resistance 548 would have been connected over the circuit just traced and only relay 810 would then be operated as soon as the district sequence switch reaches position 4. If neither relay 536 nor 547 operate, then direct ground is connected to the circuit prepared through the windings of relays 809 and 810 and neither of the latter relays will operate.

With sequence switch 600 in position 3 relay 318 is energized over a circuit extending from battery through its right winding, the lower right contact of cam 610, the lower left contact of cam 611, conductor 378, terminal 401 and brush 402 of district finder 410, the left contacts of cam 435, brush 436 and terminal 437 of sender finder 420, conductor 542, the contact of relay 521, the back contact of relay 504, right contact of cam 526, winding of sender stepping relay 522, back contact of counting relay 525, left winding of overflow relay 523, left contact of cam 527, resistance 530 to ground. Relays 522 and 318 operate, relay 318 locking over its inner right front contact, the upper left contact of cam 610, thence over the circuit traced, whereby it remains energized as the sequence switch 600 advances into position 4. Relay 318 also closes a circuit to advance sequence switch 600 into position 4, extending from battery through the winding of magnet 600, lower right contact of cam 608, the outer right front contact of relay 324, the left front contact of relay 318, conductor 319, the lower contacts of cam 807, conductor 808, left back contact of relay 302 to ground at the lower left contact of cam 604. As sequence switch 600 advances out of position 3, relays 322 and 324 release.

When the district sequence switch 600 reaches position 4 for controlling brush selection, the circuit previously traced from the contact of relay 547 and extending to the upper right contact of cam 609 is extended over the upper left contact of this cam, conductor 811 to ground through the lower windings of zone relays 809 and 810. These relays operate and lock over their upper windings and inner upper front contacts, conductor 812 to ground at the upper left contact of cam 607.

The district selector is now controlled by the sender in its brush and group selection movements 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 of sequence switch 600 for relay 318, extending from battery through its left winding, the lower contact of cam 618, the lower left contact of cam 601, the inner left back contact of relay 324 to ground at the left front contact of relay 351. Relay 318, upon operating, advances sequence switch 600 into position 10 over a circuit extending from battery, winding of magnet 600, lower right contact of cam 612, left front contact of relay 318, conductor 319, lower contacts of cam 807, conductor 808, left back contact of relay 302 to ground at the lower left contact of cam 604. In position 10, relay 318 remains energized over the circuit previously traced. In position 10 which is the selection beyond position of the district selector sequence switch, the control of succeeding switches is effected over a fundamental circuit which may be traced in part from brush 621, the upper right and lower left contacts of cam 622, the right back contact of relay 321, conductor 378, thence as traced to the sender through the windings of relays 522 and 523, cam 546, brush 544 and compensating resistance 545, the back contact of relay 524, the right front contact of relay 507, conductor 543, terminal 439 and brush 438, the right contacts of cam 405, brush 406, terminal 407, conductor 379, the right contacts of cam 624 to brush 625.

As soon as the selections are completed and the connection has been set up to the called subscriber's line, reversed battery from the incoming selector 701 operates relays 522 and 523 in the usual manner and these relays, in turn, cause the operation of the relays 531, 524 and 504. With these relays operated, the sender sequence switch is advanced to position 18 for controlling talking selection. Relay 315 is operated in parallel with the lower winding of relay 316 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 316. Relay 351 thereupon releases, in turn, opening the circuit of relay 318 which also releases. Upon the release of relay 318 the district sequence switch 600 is advanced into position 11 over a circuit extending from battery, winding of magnet 600, upper left contact of cam 608, left back contact of relay 318, thence as traced to ground at the lower left contact of cam 604. As the sequence switch enters position 11 ground is connected to conductor 314 at the lower right contact of cam 617, over terminal 433, brush 432, upper contacts of cam 446, left winding of relay 415, right back contact of relay 409, lower contact of cam 434, brush 431, terminal 430, conductor 506, left back contact of relay 505, 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 locks over its middle left contact to conductor 506 and to ground as above traced. After leaving position 10, relay 316 is disconnected from conductor 314.

With sequence switch 600 in position 11 the subscriber's line becomes disconnected from the sender at contacts of cams 615 and 617 and relay 329 is operated in a circuit extending from battery, through its upper winding, the upper back contact of relay 330, the lower right and upper left contact of cam 619 to ground at the upper right contact of cam 617. Relay 329 upon operating extends its operating circuit over its middle upper front contact to battery through the winding of relay 338 which operates. At its inner right and left front contacts relay 338 connects the winding of relay 322 to the tip and ring conductors 116 and 117 of the calling line, and establishes a holding circuit from ground at its middle left contact through the lower winding of relay 329 to insure that relay 329 will remain operated until after relay 338 has released to disconnect relay 322 from conductors 116 and 117. At the time relay 329 operated the operating ground therefore is also connected to the cam contact of interrupter 339 and thence as soon as interrupter 339 closes its lower contact to battery, through the right winding of relay 340. Relay 340 operates and locks over its inner right front contact to the operating ground independently of interrupter 339 and as soon as interrupter 339 makes its upper contact, establishes a circuit for relay 302 extending from battery through the winding of relay 302, middle right front contact of relay 338, outer right front contact of relay 340, upper contact of interrupter 339, thence to ground as traced at the upper right contact of cam 617. Relay 302 upon operating locks over its inner right front contact to ground at the lower front contact of relay 329 and at its inner left front contact establishes a circuit for advancing sequence switch 600 into position 12. This circuit extends from battery through the winding of magnet 600, the upper left contact of cam 612, conductor 620, the upper right and lower left contacts of cam 801, conductor 802, the inner left front contact of relay 302 to ground at the lower left contact of cam 604. Upon leaving position 11¼ the operating circuits of relays 329 and 338 and the holding circuit of relay 340 are opened and relays 338 and 340 release. Relay 338, upon releasing, opening the holding circuit of relay 329 which in turn releases, opening the holding circuit of relay 302.

It has been assumed that the substation J has initiated the call and that therefore when relay 322 was connected to the calling line conductors upon the operation of relay 338 it did not operate as the operating ground at substation J extends through the substation bell and a condenser. Since relay 322 did not operate no circuit was established thereby for operating the message register switching relay 324 and therefore the fact that relay 324 is not operated registers in the district circuit that the party J has initiated the call. Had the party W initiated the call then when the test relay 322 is connected to the line conductors the circuit of relay 322 is completed through the substation bell of the substation W to ground, and relay 322, upon operating, operates relay 324 which then locks over its inner right front contact to ground at the lower left contact of cam 617, registering the fact that the party W has initiated the call.

Talking selection

With sequence switch 600 in position 12 the calling substation is connected in a talking path extending from ground through the upper left winding of repeating coil 631, lower right contact of cam 615, upper back contacts of relays 316 and 329, brush 334, terminal 333, line conductor 116, through the calling substation J, line conductor 117, terminal 332, brush 331, lower back contacts of relays 329 and 316, winding of supervisory relay 320, upper contacts of cam 617 to battery through the lower left winding of coil 631. Relay 320 operates in this circuit and remains operated until the calling subscriber hangs up and establishes a circuit for relay 301 extending over the contact of relay 320, the upper right and lower left contacts of cam 605 to ground at commutator brush 336. A circuit is also established for relay 318 extending from battery through its right winding, the lower right contact of cam 610, lower left contact of cam 611, conductor 378, terminal 401, brush 402, left contacts of cam 435, brush 436, terminal 437, conductor 542, front contact of relay 521, front contact of relay 504, right contact of cam 526, the sender sequence switch being in position 18 for talking selection, windings of relays 522 and 523, right contact of cam 527, right back contact of relay 507 to ground through resistance 530. Relays 318 and 522 energize relay 318 closing a circuit extending from battery through sequence switch magnet 600, the lower right contact of cam 612, the left front contact of relay 318, thence to ground at the lower left contact of cam 604, as previously traced. Relay 318, upon energizing, locks over its inner right front contact, the upper left contact of cam 610, thence over the fundamental circuit as traced. As sequence switch 600 rotates out of position 12 toward position 16, ground is intermittently connected to the fundamental circuit in shunt of sender stepping relay 522 over the upper contacts of cam 606. 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. Relay 318 deenergizes arresting sequence switch 600 in its next stopping position. The sequence switch may be arrested in any one of three positions, position 13, which is a charging position for connections to zones 0, 2 and 4, position 14 which is a charging position for connections to zones 1, 3 and 5 and position 15 for connections to an operator's position. Since it has been assumed that the calling subscriber has made a call to zone 5 of the exchange, the district selector sequence switch will be arrested in talking selection position 14.

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 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 condition exists relay 417 is held operated in a circuit from battery over its left winding and 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 right contact of cam 416 to ground. Relay 409 locks through its inner left contacts to ground at the lower contacts 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 downdrive 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, lower right contact of cam 456 to resistance 411, shunting the winding of relay 409 and causing that relay to release, in turn, releasing 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 right 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 selector which is standing in position 1 awaiting association with a link and a circuit will be closed from ground over the upper right contact of cam 617, the upper left contact of cam 619, the lower right contact of cam 623, contacts 341 of jack 340, conductor 392, contact of jack 448, contact of jack 449, upper right contacts 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 updrive magnet 447 of the district finder 410, lower right contact of cam 479, outer right front contact of relay 417, left back contact of relay 409 to ground. The finder 410 moves upwardly under control of magnet 447 in search of the district selector which is awaiting a link. Such a district selector is identified by battery connected to conductor 366 over the upper contact 342 of jack 340 and the lower left contact of cam 626. 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 conductor 366, terminal 450, brush 451, contact of jack 449, upper left and lower right contacts of cam 419, right back contact of relay 409, left winding of relay 415, lower contacts of cam 421, middle winding of relay 415, to ground at the right contact of relay 413.

If the district selector for which the finder 410 is hunting does not lie between the last position occupied by the finder and the top of the bank, it will continue to move upwardly 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. Relay 409 opens the test circuit, opens the circuit of updrive magnet 447 and closes a circuit from battery through the winding of downdrive magnet 454, lower contact of cam 412, left front contact of relay 409 to ground. The finder 410 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 finder commutator, upper right contact of cam 456, resistance 411 to battery, shunting and releasing relay 409 which restores the test circuit and the circuit of updrive magnet 447. When brush 451 encounters terminal 450 to which conductor 366 extends the test circuit is completed and relay 415 operates, locking through its right winding, the upper right and lower left contacts of cam 421 to ground at its outer left front contact, opening the circuit of relay 417 to deenergize magnet 447

and to bring the finder 410 to rest on the terminals of the district selector. 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, the left back contact of relay 413, right front contact of relay 415, upper contact of cam 416, contacts of jacks 449 and 448 to ground on conductor 392, advancing sequence switch 400 to position 8.

Relay 415 is held operated in position 8 from battery at the district selector over terminal 450, brush 451, contacts of jack 449, upper left and lower right contacts of cam 419, back contact of relay 409, left winding of relay 415, lower 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 right lower contact of cam 416, right front contact of relay 415, the upper left contact of cam 429, brush 478, terminal 477, conductor 375, upper right contact of cam 611, lower right contact of cam 610 to battery, through the right winding of relay 318. Relay 318 operates and closes a circuit from battery through the winding of sequence switch magnet 600, lower right contact of cam 612, left front contact of relay 318, conductor 319, lower contacts of cam 807, conductor 808, left back contact of relay 302 to ground at the lower left contact of cam 604, sequence switch 600 advancing to position 2, releasing relays 318 and 415. Relay 415, upon releasing, closes 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 right contact of cam 416 for advancing sequence switch 400 to position 9. The link circuit remains in this position until the link 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, the right contact of cam 262, conductor 263, contact 460 of jack 428, right contacts of cams 461 and 462 to battery through the winding of sequence switch magnet 400, advancing the sequence switch 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.

Making initial charge for a call in zone 5 of the exchange area

It will be recalled that for a call into zone 5 of the exchange area the district sequence switch 600 was arrested in talking position 14 and that both zone relays 809 and 810 have been operated and locked. When the called subscriber 700 responds after the application of ringing current to his line from the incoming selector 701, in the well known manner, relay 627 operates in a circuit which may be traced in part from brush 621, the upper contacts of cam 622, the upper right winding of repeating coil 631, winding of relay 627, lower right winding of coil 631, upper contacts of cam 624, to brush 625. Upon operating, relay 627 establishes a circuit from ground at the right contacts of cam 607, front contact of relay 627, upper contacts of cam 623, conductor 628, right contacts of cam 813, conductor 814, lower contact of interrupter 343, conductor 815, upper left and lower right contacts of cam 816, conductor 817, left winding of relay 340 to battery. Relay 340 operates and locks over the circuit previously traced to conductor 814, thence over the outer left front contact of relay 340, conductor 815, thence as traced to battery through the left winding of relay 340. As soon as interrupter 343 makes its upper contact, a circuit is established from battery through the winding of sequence switch magnet 800, lower right contact of cam 818, right contacts of cam 819, conductor 822, upper contacts of cam 618, conductor 630, inner left front contact of relay 340, upper contact of interrupter 343, conductor 814, thence to ground as traced over the front contact of relay 627, to ground at the right contacts of cam 607 for advancing sequence switch 800 into position 2. Upon leaving position 1 the holding circuit of relay 340 is opened and relay 340 releases.

As soon as sequence switch 800 leaves normal, a circuit is established for relay 325, extending from battery through the winding of relay 325, conductor 345, upper right and lower left contacts of cam 816, conductor 831, to ground at the lower left contact of cam 617. Relay 325 upon operating extends its operating ground to the winding of relay 321 over its inner right front contact, thereby operating relay 321 which locks itself and relay 325 over its inner left front contact to ground at the lower contacts of cam 607.

With sequence switch 800 in position 2, a start circuit is established from ground on conductor 628, over the lower left contact of cam 813, upper winding of relay 823, conductor 824, left back contact of relay 1000, right back contact of relay 1001, right back contact of relay 1002, winding of relay 1003, to battery at the back contact of relay 1004, if the message register connector circuit of Figs. 10 and 11 is at the time free. Relays 1003 and 823 operate and if the timing circuit of Fig. 8 occupies a preferential position with respect to other timing circuits, relay 823 locks over its lower winding, the left contacts of cam 825, the upper front contact of relay 823, conductor 826, right back contact of relay 1000, winding of relay 1004, to ground at the left back contact of relay 1002. Relay 1004 operates in this locking

circuit, opens the previously traced start circuit through the winding of relay 1003 and establishes an obvious circuit for relay 1005. Relay 1005 upon operating establishes an obvious circuit for relay 1001 thereby connecting the start conductor 824 over the left back contact of relay 1000, the right front contact of relay 1001 to ground through the winding of relay 1006. Relay 1006 does not operate at this time. Relay 827 also operates in parallel with the locking winding of relay 823, extending common operating leads 850 from the connector circuit to the district selector circuit and at its middle upper front contact establishes a circuit from ground over conductor 828, to battery through the winding of relay 344, thereby operating this relay. A circuit is now established either for relay 900 or relay 901 depending upon whether the party test relay 324 was or was not operated. In the case assumed, relay 324 was not operated and therefor with relay 344 operated, relay 900 is operated over a circuit extending from battery, winding of relay 902, winding of relay 900, conductor 903, inner upper from contact of relay 344, left back contact of relay 324, lower front contact of relay 344, lower contacts of cam 605, commutator segment 335, brush 336 to ground. Had relay 324 operated through the initiation of a call by the party W, then relay 901 is operated from battery, winding of relay 902, winding of relay 901, conductor 904, upper front contact of relay 344, left front contact of relay 324, thence to ground as traced at brush 336. Relay 902 being marginal does not operate in the circuit of either relay 900 or relay 901.

With relay 900 operated circuits are closed for five multi-contact relays, one of which is shown at 905, and each relay 905 extends its operating circuit to a corresponding multi-contact relay 906. Each multi-contact relay, such as 905 and 906, controls operating circuits extending to forty message registers, and thus as soon as five relays similar to relay 905 and five relays similar to relay 906 are operated through the operation of relay 900, the message registers of all substations corresponding to the substation J of the 400 lines appearing in the line finder in Fig. 3 are connected through the contacts of these relays to the corresponding operating conductors of the 400 lines terminating in terminals corresponding to terminal 380 appearing in the line finder bank. For example the circuit of message register 105 of the calling party J may be traced in part from terminal 380, conductor 114, the back contact of line relay 101, conductor 106, the outer right front contact of relay 905, conductor 907 to ground through message register 105. Had relay 901 operated, in turn operating five multi-contact relays corresponding to relay 908 and in turn five multi-contact relays corresponding to relay 909, then the message registers of all substations corresponding to the substation W of the same 400 lines would be connected to the operating conductors of the 400 lines terminating in terminals corresponding to terminal 380. For example, in that case the circuit through message register magnet 135 may be traced in part from terminal 380, conductor 114, back contact of line relay 101, conductor 106, the outer right front contact of relay 908, conductor 910 to ground through message register 135.

With either relay 900 or 901 operated, a circuit is established from ground in parallel through back contacts of multi-contact relays controlled thereby to battery through the winding of relay 911. Relay 911 operates and remains operated until all of the multi-contact relays, such as 905, 906 which should operate have operated, and at its left back contact opens the operating circuit of charging relay 1007 to prevent initiation of charging. In the event that both relays 900 and 901 operate erroneously, the marginal relay 902 will receive current to operate and will in turn hold relay 911 operated to prevent charging.

Referring to the operation of the timing circuit of Fig. 8, it will be recalled that sequence switch 800 is standing in position 2 and that relays 823 and 827 are operated. It will also be recalled that for calls to zones 0, 2 or 4, sequence switch 600 will be standing in position 13 and that for calls to zones 1, 3 or 5 it will be standing in position 14. A test is now made of the continuity of common conductors 850 extending through front contacts of relay 827 to the windings of zone relays in the connector circuit. One of these test circuits extends from battery through the winding of relay 913, winding of zone relay 914, conductor 835, upper front contact of relay 827, left contacts of cam 834, to ground at the inner lower front contact of relay 810 if relay 810 is operated, or over the inner lower back contact of this relay, the left contacts of cam 839 to ground at the lower front contact of relay 823, if relay 810 is not operated. Another circuit extends from battery through the winding of relay 913, the winding of relay 915, conductor 1010, the right back contact of relay 1008, conductor 836, the lower front contact of relay 827, the lower right and upper left contacts of cam 829 to ground at the upper front contact of relay 809 if it is operated, or if it is not operated over its upper back contact through the left contacts of cam 839 to ground at the lower front contact of relay 823. If sequence switch 600 is in position 13, a circuit is established from battery, winding of relay 913, winding of zone relay 912, conductor 840, inner lower front contact of relay 827, left contacts of cam 842, upper front contact of relay 810, which is operated

for all calls to zones 2 or 4, conductor 632, upper right contact of cam 601, upper right contact of cam 618, conductor 630, outer left front contact of relay 321, conductor 832, upper contacts of cam 813, conductor 628, upper contacts of cam 623, front contact of relay 627, to ground at the right contacts of cam 607. If sequence switch 600 is in position 14, a circuit is established from battery, winding of relay 913, winding of zone relay 917, conductor 833, inner upper front contact of relay 827, upper left and lower right contacts of cam 819, conductor 822, upper contacts of cam 618, thence to ground at cam 607 as previously traced. A circuit is also established for relay 916, extending from battery, winding of relay 916, conductor 838, middle lower front contact of relay 827, right contacts of cam 837, conductor 808, left back contact of relay 302, to ground at the lower left contact of cam 604. If the conductors 850 are continuous relays 913 and 916 and either zone relays 914, 915 and 912 or zone relays 914, 915 and 917 are operated.

With either zone relay 912 or 917 operated and relays 914, 915 and 916 operated, a circuit is established for relay 1009 extending from battery, winding of relay 1009, inner right back contact of relay 1008, left front contact of relay 916, outer left front contact of relay 914, inner right front contact of relay 915, to ground either on the inner left front contact of relay 912 or relay 917, relay 1009 operating in this circuit and locking through the winding of relay 1008 and its right front contact to ground at the left front contact of relay 1004. Relay 1008 being shunted does not, however, operate in this locking circuit. A circuit is now established from ground at the left back contact of relay 1008, the left front contact of relay 1009, the right back contact of relay 1011, conductor 843, inner lower front contact of relay 344, conductor 346, lower contacts of cam 844, upper contacts of cam 845, winding of relay 821, right contacts of cam 804, conductor 312, winding of relay 305, conductor 311, right contacts of cam 803, conductor 846, resistance 633 to battery. Relay 321 operates in this circuit advancing sequence switch 800 into position 3 over a circuit extending from battery, winding of magnet 800, upper contacts of cam 841 to ground at the inner upper front contact of relay 821. When sequence switch 800 leaves position 2, relay 821 releases opening the circuit of magnet 800 at the upper right contact of cam 803. From position 3 sequence switch 800 advances into position 4 over a circuit extending through the winding of magnet 800, the upper left contact of cam 818 to ground at the lower front contact of relay 823. When sequence switch 800 leaves position 2, the test grounds are removed from conductors 835, 836 and 838 at contacts of cams 839 and 837 and only those conductors which are grounded through the setting of sequence switch 600 or the operation of zone relays 809 and 810 will remain effective. It has been assumed that a call has been extended to zone 5 and that therefore relays 809 and 810 are both operated and sequence switch 600 is in position 14. Therefore conductors 835 and 836 will be grounded over front contacts of zone relays 809 and 810 and conductor 833 will be grounded over the upper contacts of cam 618 of sequence switch 600. When sequence switch 800 leaves position 2, relays 913, 914 and 917 will therefore remain operated and relay 916 will release. Relay 916 upon releasing removes the shunt ground from one terminal of relay 1008 and this relay then operates in the locking circuit of relay 1009, disconnecting the winding of zone relay 915 from conductor 836 and connecting ground at the right back contact of relay 1012 over the right front contact of relay 1008, conductor 836, the lower front contact of relay 827, the lower contacts of cam 829, the upper right contact of cam 818 to battery through the winding of sequence switch magnet 800, thereby advancing sequence switch 800 into position 5.

With sequence switch 800 in position 5, a circuit is established from battery through the right winding of relay 1012, left front contact of relay 1008, left front contact of relay 1009, right back contact of relay 1011, conductor 843, inner lower front contact of relay 844, conductor 346, lower right and upper left contacts of cam 844, conductor 310, brush 381, terminal 380, thence to ground as previously traced through the winding of message register 105. The message register 105 does not operate in series with relay 1012, but relay 1012 operates locking over its left winding and the inner left front contact to ground at the left front contact of relay 1004. Relay 1012 upon operating also disconnects ground from conductor 836 and connects this conductor over the right front contact of relay 1008, inner right front contact of relay 1012, to battery through the winding of zone relay 915. As zone relay 809 is operated, relay 915 again operates. At its outer right front contact, relay 1012 establishes a circuit extending from battery through the winding of relay 1007, front contact of relay 1012, back contact of relay 911 to ground at the inner left front contact of relay 905, relay 1007 in turn closing an obvious circuit for relay 1011. Relay 1011 at its inner right front contact establishes a new holding circuit for relay 1001 at its outer right front contact, opens the initial operating circuit for relay 1012, and at its left contact closes a circuit from ground over conductor 1013, contacts of interrupter 918, right back contact of relay 916, inner right front contact of relay 915, outer right back contact of relay 912, outer right front contact of relay

917, back contact of counting relay 919, to battery through the right winding of relay 920 as soon as interrupter 918 closes its contacts.

Relay 920 operates and locks through the right winding of relay 919, right front contact of relay 920, conductor 1014 to ground at the inner right front contact of relay 1007, but relay 919 being shunted does not operate in this locking circuit until the interrupter 918 opens its contacts. Relays 919 and 920 when operated both lock over their left windings and left front contacts to ground at conductor 1014, relay 919 extending its operating circuit its outer left front contact, outer left back contact of relay 921 to battery through the right winding of relay 922 and at its right front contacts also closes a circuit for relay 1015 which may be traced through the winding of this relay, conductor 1016, right back contact of relay 929, left back contacts of relays 928, 926, 924, 922, right front contact of relay 919 to ground on conductor 1014. Relay 1015 operates and at its left front contact connects message register operating battery to conductor 843 thence as traced to ground through the message register 105, thus operating the message register to record a single charge.

Upon the next closure of interrupter 918, relay 922 operates and locks through the right winding of relay 921 and its own right front contact to ground on conductor 1014. Upon the next opening of interrupter 918, relay 921 operates, both relays 921 and 922 locking over their left windings and left front contacts to ground on conductor 1014. At its left back contact, relay 922 opens the circuit of relay 1015 which in turn releases the message register magnet 105. Relay 921 upon operating reestablishes the circuit of relay 1015 at its right front contacts whereupon relay 1015 closes the circuit for again operating the message register 105. In this manner, relays 923 to 928 are successively operated under the control of interrupter 918 thereby causing three more operations of relay 1015 and of message register magnet 105. The message register 105 has thus been operated five times. Relays 927 and 928 upon operating lock to ground at the left front contact of relay 1011 over conductor 1013, relay 927 extending the operating circuit from interrupter 918 as previously traced through the outer left front contacts of relays 919, 921, 923, 925 and 927 to the winding of relay 929 which operates upon the next closure of interrupter 918 and locks over its right front contact, the right front contacts of relay 927 to ground on conductor 1013. At its right back contact relay 929 opens the circuit of relay 1015 thereby releasing the message register magnet 105. At its left front contact relay 929 establishes a circuit over conductor 1017 to battery through the winding of relay 1002. Relay 1002 operates releasing relay 1004, relays 823 and 827 of the timing circuit and relay 344 of the district selector circuit. With relay 823 released a circuit is established for advancing sequence switch 800 into position 7, extending from battery through the winding of magnet 800, the lower left contact of cam 818 to ground at the lower back contact of relay 823.

Upon the advance of the timing switch 800 the operated zone relays 913, 914, 915 and 917 are released and the release of relay 344 releases relay 900. The release of relay 900 releases the multi-contact relays 905, and 906 and in turn relays 1007 and 1011. Relays 1007 and 1011 upon releasing release relays 1008, 1009, 1005 and 1012, 919 to 929 inclusive, and relay 1001. Relay 929 upon releasing releases relay 1002. The message register connector circuit is now restored ready to handle the next call. In the event that the called party hangs up before the initial registration is completed, the timing sequence switch 800 is advanced out of position 5 in a manner which will be hereinafter described, thereby releasing relays 1004, 823, 827 and 344. Relay 1001 does not release in this case thereby holding the conductor 824 open until relays 1007 and 1011 release following the release of relay 900 and multi-contact relays 905 and 906. Relays 1008, 1009, 1005 and 1012 are also held operated until after the release of relay 1007.

Making initial charge for calls into other zones of the exchange area

In the preceding description it has been assumed that the call was for a subscriber's line terminating in zone 5 of the exchange area. At this point the description of the progress of such a call will be arrested to describe how calls to other zones of the exchange area are charged for. It will be recalled that in the operation of the sender relay 536 operated alone for calls to certain zones, relay 547 operated alone for calls to other zones and that neither of these relays operated for calls to other zones, and that the relay 536 operated the zone relay 810 of the timing circuit was operated and locked, that with relay 547 operated both zone relays 809 and 810 operated and locked, and with neither relay 536 nor relay 547 operated, neither zone relay 809 or 810 operated. Further, it will be recalled that for calls to zones 0, 2 and 4 the district sequence switch 600 was set into talking position 13 and that for calls to zones 1, 3 and 5 sequence switch 600 was set into position 14.

If therefore a local call is made terminating in zone 0 for which no charge should be made, neither of zone relays 809 or 810 will be operated and sequence switch 600 will be in position 13. Under this condition when the called subscriber answers and relay

627 operates, relay 340 operates under the control of interrupter 343 and locks as previously described, but the circuit for advancing the timing switch into position 1 is not effective since it is open at the right contact of cam 618. With relay 340 operated and sequence switch 800 in position 1, a circuit is established from battery, through the winding of relay 321, conductor 347, upper back contact of relay 810, conductor 632, upper right contact of cam 601, upper right contact of cam 618, conductor 630, inner left front contact of relay 340, upper contact of interrupter 343, conductor 814, right contacts of cam 813, conductor 628, upper contacts of cam 623, front contact of relay 627 to ground at the right contacts of cam 607. Relay 321 upon operating locks over its inner left front contact to ground at the lower contacts of cam 607. Since the timing switch 800 does not leave normal, the message register connector is not seized and no circuit is established for the calling party's message register. The circuits remain in the condition described until the calling subscriber releases as later explained.

Had the subscriber made a call into zone 1 neither of the zone relays 809 or 810 would be operated and sequence switch 600 would be positioned in position 14. When timing switch 800 advances into position 2, in the manner previously described in connection with the call to zone 5, and establishes test circuits over the common conductors 850 extending to relays 912 to 917 inclusive, these relays operate as previously described and relay 1009 operates, locking through the winding of relay 1008 and establishing the previously traced circuit for relay 821 for advancing sequence switch 800 into position 4. Upon leaving position 2 the circuits of zone relays 914 and 915 are opened since neither relay 809 or 810 is operated and the circuit of relay 916 is opened. Consequently only zone relay 917 of the connector circuit remains operated. Relay 915 upon releasing permits relay 1008 to operate for advancing sequence switch 800 into position 5.

Relay 1012 then operates as previously described, in turn operating relays 1007 and 1011. With relay 1011 operated a circuit is established for relay 928 which may be traced from ground at the left contact of relay 1011, conductor 1013, contacts of interrupter 918, back contact of relay 916, right back contact of relay 915, inner right back contact of relay 912, left front contact of relay 917, inner right back contact of relay 914, left back contact of relay 927 to battery through the right winding of relay 928. Relay 928 operates and locks through the right winding of relay 927 and its own right front contact to ground on conductor 1013, but relay 927 does not operate in this locking circuit until the interrupter 918 opens its contacts. Relays 927 and 928 when operated both lock over their left windings and left front contacts to ground on conductor 1013, relay 927 extending the operating circuit from interrupter 918 over its outer left front contact to the winding of relay 929. At its right front contacts relay 927 also closes a circuit for relay 1015 which extends through the winding of relay 1015, over conductor 1016, right back contact of relay 929, right contacts of relay 927 to ground on conductor 1013. Relay 1015 operates and in turn operates the message register 105 in the manner previously described. When relay 929 operates upon the next closure of the contacts of interrupter 918, the circuit of relay 1015 is opened to release the message register 105. From this point the circuits function in the manner previously described to advance the sequence switch 800 to position 7 and to cause the release of the message register connector circuit. Thus for a call to zone 1 the message register 105 has been operated but once.

Had the subscriber made a call into zone 2, zone relay 810 would have been operated and sequence switch 600 would have been set into position 13. Following the application of test grounds to the common operating conductors 850 and the advance of sequence switch 800 into position 4, zone relays 914 and 912 remain operated. Therefore, when relay 1011 operates as previously described, a circuit is established from ground on conductor 1013, contacts of interrupter 918, back contact of relay 916, right back contact of relay 915, inner right front contact of relay 912, inner left front contact of relay 914, left back contact of relay 925 to battery through the right winding of relay 926. Thereafter relays 925 to 929 function under the control of interrupter 918, relays 925 and 927 causing the operation and release of relay 1015 twice to cause two operations of the message register 105. Following the operation of relay 929 the circuits function as previously described.

Had the subscriber made a call into zone 3, zone relay 810 would have been operated and sequence switch 600 would have been set into position 14. Following the application of test grounds to the common operating conductors 850 and the advance of sequence switch 800 into position 4 zone relays 914 and 917 remain operated. Therefore, when relay 1011 operates as previously described a circuit is established from ground on conductor 1013, over contacts of interrupter 918, back contact of relay 916, right back contact of relay 915, inner right back contact of relay 912, outer left front contact of relay 917, inner right front contact of relay 914, left back contact of relay 923 to battery through the right winding of relay 924. Thereafter relays 923 to 929 function under the control of interrupter 918, relays 923, 925 and 927

causing the operation and release of relay 1015 three times to cause three operations of the message register 105. Following the operation of relay 929 the circuits function as previously described.

Had the subscriber made a call to zone 4, zone relays 809 and 810 would have been operated and sequence switch 600 would have been set into position 13. Following the application of test grounds to the common operating conductors 850 and the advance of sequence switch 800 into position 4, zone relays 914, 915 and 912 remain operated. Thereafter when relay 1011 operates as previously described a circuit is established from ground over conductor 1013, contacts of interrupter 918, back contact of relay 916, outer right front contact of relay 915, outer right front contact of relay 912, left back contact of relay 921 to battery through the right winding of relay 922. Thereafter relays 921 to 929 function under the control of interrupter 918. Relays 921, 923, 925 and 927 cause the operation and release of relay 1015 four times to cause four operations of the message register 105. Following the operation of relay 929 the circuits function as previously described.

Timing the initial period of conversation for calls to zone 5

Returning now to the consideration of the call which, it was assumed, the calling subscriber J had made to subscriber's line 700 terminating in zone 5, it will be recalled that following the completion of registration for the initial period of conversation, sequence switch 800 advanced into position 7. A circuit is now closed from the office timing circuit 830 over upper contacts of cam 820, the lower back contact of relay 821, conductor 312, winding of relay 305, conductor 311, right contacts of cam 803, conductor 846 to battery, operating relay 305. Relay 305 locks from ground, over brush 307 and commutator segment 306, its own front contact, conductor 313, right contacts of cam 845, winding of relay 821, right contacts of cam 804, thence as traced to battery on conductor 846. Relay 821 operates in this locking circuit as soon as ground is removed at the office timing circuit 830 and establishes a circuit from ground at its inner upper front contact, upper contacts of cam 841 to battery through the winding of magnet 800 thus advancing sequence switch 800 out of position 7. Upon leaving position 7 the holding circuit of relays 821 and 305 is opened at the right contacts of cam 803 and these relays release, relay 821 opening the circuit of magnet 800 to arrest the sequence switch in position 8. Sequence switch 800 is thus advanced from position to position into position 12 at thirty-second intervals under the control of timing switch 830, measuring off five intervals or from 2 to 2½ minutes.

Since zone relays 809 and 810 are both operated for a call to zone 5, when sequence switch 800 reaches position 12 a circuit is closed from battery, through the winding of sequence switch 800, the upper right contact of cam 818, the lower front contacts of relay 809, upper contacts of cam 847 to ground at the lower left contact of cam 848 whereby the sequence switch is advanced directly into position 16. From position 16 sequence switch 800 is advanced into position 18 under the control of office timing circuit 830 and relays 305 and 821 over the circuit previously described thus measuring off an additional one minute period for conversation. Thus in advancing from position 7 into position 8 a total period of approximately three minutes has been measured off.

As sequence switch 800 passes through position 16 a circuit is closed for relay 302 extending from battery, winding of relay 302, conductor 348, right contacts of cam 849, conductor 831 to ground at the lower left contact of cam 617. Relay 302 upon operating locks over its inner right front contact, the left contacts of cam 605 to ground over commutator segment 335 and brush 336. With sequence switch 800 in position 18 a check is made to determine if conversation is still in progress. If the calling and called subscribers have not disconnected, relays 320 and 627 will be operated and a circuit will be established for relay 821 extending from battery, over conductor 846, the upper right and lower left contacts of cam 803, resistance 806, the right contacts of cam 845, winding of relay 821, upper right and lower left contacts of cam 804, conductor 851, front contact of relay 320, upper right and lower left contacts of cam 605 to ground at commutator brush 336. With relay 821 operated a circuit is established for advancing sequence switch 800 into position 1 extending from battery, winding of magnet 800, upper right contact of cam 818, lower front contact of relay 810, lower contacts of cam 839, conductor 852, outer left front contact of relay 302, conductor 349, upper front contact of relay 821, right contacts of cam 848, conductor 853, front contact of relay 627 to ground at the right contacts of cam 607. With sequence switch 800 in position 1 relay 821 releases. From position 1 sequence switch 800 advances into position 2 over a circuit extending from battery, winding of magnet 800, lower right contact of cam 818, the right contacts of cam 819, conductor 822, upper contacts of cam 618, conductor 630, outer left front contact of relay 321, conductor 832, left contacts of cam 849, conductor 852, left front contact of relay 302, conductor 349, right contacts of cam 825, conductor 854, left contacts of cam 605 to ground at commutator brush 336.

In position 2 of sequence switch 800 the message register connector circuit is again seized in the manner previously described and relays 900, 905, 906, 913, 914, 915, 916 and 917 are again operated. Relay 1009 operates as previously described upon the operation of relays 914 to 917 inclusive and locks through the winding of relay 1008 advancing sequence switch 800 into position 4. When sequence switch 800 leaves position 2 relays 914, 915 and 917 remain operated and a circuit for relay 916 is maintained from battery, through the windings of relays 913 and 916, conductor 838, middle lower contact of relay 827, upper right and lower left contacts of cam 837, conductor 802, inner left front contact of relay 302 to ground at the lower left contact of cam 604. Relay 915 releases since its circuit is opened at the upper left contact of cam 829 and on releasing, removes the shunt from the winding of relay 1008 which now operates advancing sequence switch 800 to position 5. Relay 1012 now operates and with sequence switch 800 in position 5 and zone relay 809 operated, relay 915 again operates. Relay 1012 also causes the operation of relays 1007 and 1011 in the manner previously described. The connector circuit is now prepared for controlling charging for the first overtime period of conversation under the control of operated zone relays 914, 915 and 917 and overtime relay 916.

With relay 1011 operated a circuit is now established from ground at the left front contact of relay 1011, conductor 1013, contacts of interrupter 918, right front contact of relay 916, inner right front contact of relay 917, outer right front contact of relay 914, conductor 933 patched to conductor 934, left front contact of relay 915, conductor 930 patched to conductor 931, left back contact of relay 925 to battery through the winding of relay 926. Relay 926 operates in this circuit as soon as interrupter 918 closes its contacts and locks through the right winding of relay 925 and its own right contact to ground on conductor 1014. Relay 925, however, being shunted does not operate in this locking circuit until interrupter 918 opens its contacts. When relay 925 operates, it extends the operating circuit previously traced from interrupter 918 the left front contact of relay 925, the left back contact of relay 927 to battery through the right winding of relay 928 and at its right contact establishes a circuit for relay 1015 extending from battery, winding of relay 1015, conductor 1016, right back contact of relay 929, left back contact of relay 928, right front contact of relay 925 to ground on conductor 1014. Relay 1015 in operating, operates the message register 105 as previously described. Relays 925 and 926 both lock over their left windings and left front contacts to ground on conductor 1014. When the interrupter 918 again closes its contacts relay 928 operates locking through the right winding of relay 927 and its own right contact to ground on conductor 1013 and opens at its left back contact the circuit of relay 1015 which releases, in turn releasing the message register. When the interrupter 918 again opens its contacts, relay 927 operates in the locking circuit of relay 928 extending the operating circuit from the interrupter 918 to the winding of relay 929 and at its right front contact establishes a circuit for relay 1015 extending over conductor 1016, the right back contact of relay 929, the right contacts of relay 927 to ground on conductor 1013. Relay 1015 operates and, in the manner previously described, operates the message register 105 again. Relays 927 and 928 when operated both lock over their left windings and left front contacts to ground on conductor 1013. Upon the next closure of interrupter contacts 918 relay 929 operates opening the circuit of relay 1015 thereby releasing the message register 105 and closes the circuit of relay 1002. From this point the circuits function as previously described to advance the timing switch 800 into position 7, releasing relays 823 and 827 and releasing the message register connecting circuit to normal in readiness to handle another call. The message register 105 has thus been operated twice for the overtime period of conversation.

Since at this time relay 302 is operated, timing switch 800 is immediately advanced into position 8 over a circuit extending from battery, winding of magnet 800, the upper left contact of cam 818, conductor 852, the upper left front contact of relay 302, conductor 349, the upper left and lower right contacts of cam 801 to ground at the lower back contact of relay 823. Since the call has been assumed to have been made to zone 5, zone relay 810 will be operated and sequence switch 800 will advance directly to position 12 over a circuit from battery, through magnet 800, the upper right contact of cam 818, the lower front contact of relay 810, the lower contacts of cam 839, conductor 852, the outer left front contact of relay 302, conductor 349, the upper right and lower left contacts of cam 855, the lower contact of cam 847 to ground at the lower left contact of cam 848. Since zone relay 809 is also operated, sequence switch 800 will then advance into position 16 over a circuit extending from battery, winding of magnet 800, the upper right contact of cam 818, the lower front contacts of relay 809, upper contacts of cam 847 to ground at the lower left contact of cam 848. In position 16 a circuit is established from the office timing circuit 830, over the upper contacts of cam 829, the lower contact of relay 821, conductor 312, winding of relay 305, conductor 311, right contacts of cam 803, conductor 846 to battery. Relay 305 locks from ground on brush 307, seg-

ment 306, its own front contact, conductor 313, right contacts of cam 845, winding of relay 821, right contacts of cam 804, thence as traced, to battery on conductor 846. Relay 821 operates in this circuit as soon as ground is removed at the office timing circuit 830 and establishes a circuit from ground at its inner upper front contact, upper contacts of cam 841 to battery through the winding of magnet 800 thus advancing sequence switch 800 into position 17. Upon leaving position 16 the holding circuit of relays 305 and 821 is opened and these relays release, relay 821 opening the circuit of magnet 800 to arrest the sequence switch in position 17. From position 17 sequence switch 800 is advanced in the same manner into position 18. Thus in advancing from position 16 to position 18 a time interval of one minute for overtime conversation has been measured.

When sequence switch 800 reaches position 18 a check is again made to determine if the conversation is still continuing and if so, sequence switch 800 is advanced in another revolution to seize the common register connector circuit for charging for an additional overtime period and to time such overtime period in the manner just described.

Charging and timing overtime periods for calls to zones 0 to 4 inclusive

For calls to the local zone 0 it will be recalled that since sequence switch 600 is set into position 13 the timing switch 800 is not advanced out of position 1 and therefore no timing or charging is made for either the initial or overtime periods of conversation. For calls to zone 1 with sequence switch 600 in position 14 and zone relays 609 and 610 both non-operated, following the seizure of the common message register connector circuit with switch 800 in position 4 zone relay 917 remains operated and relay 916 is operated. Therefore when sequence switch 800 is advanced to position 5 and relays 1007 and 1011 operate as previously described, a circuit is established from ground at the left contact of relay 1011, over conductor 1013, contacts of interrupter 918, right front contact of relay 916, inner right front contact of relay 917, outer right back contact of relay 914, left back contact of relay 915, left back contact of relay 927 to battery through the winding of relay 928. Under the control of interrupter 918, relays 927, 928 and 929 operate causing a single operation of relay 1015 and in turn a single operation of message register 105. Following the operation of relay 929 the sequence switch 800 is advanced to position 7 releasing relays 823 and 827 and releasing the common connector circuit. From position 7 sequence switch 800 is advanced into position 8 in the manner described in connection with a call to zone 5. Since zone relays 809 and 819 are both normal, the previously traced circuits for advancing sequence switch 800 directly into position 16 are not closed and sequence switch 800 is therefore advanced into position 18 under the control of office timing circuit 830 and relays 305 and 821 in the manner previously described, to measure off a full five minutes for conversation. In position 18 a check is again made to determine if the conversation still continues and if so, sequence switch 800 is advanced into position 2 and thereafter a further cycle of operations of time switching 800 and the message register connector circuit is initiated.

If no overtime charging is desired for calls to zone 1, the strap 856 to the upper right contact of cam 834 which establishes a bridge around the lower front contacts of relay 810 through the right contacts of cam 834 and the lower contacts of cam 839 is omitted. Therefore, since zone relay 810 is not operated for calls to zone 1 there is no effective circuit for advancing sequence switch 800 out of position 18 when the test is made to determine if the conversation is still continuing and therefore sequence switch 800 remains in position 18 for the remainder of the conversation and no further charging or timing is possible.

For calls to zone 2 with sequence switch 600 in position 13 and zone relay 810 operated, when the check is made to determine if the subscribers are still conversing at the end of the initial period of conversation, sequence switch 800 will be advanced out of position 18 into position 1. From position 1 sequence switch 800 advances into position 2 over a circuit from battery, winding of magnet 800, lower right contact of cam 818, the upper front contact of relay 810, conductor 632, the upper right contact of cam 601, the upper right contact of cam 618, conductor 630, outer left front contact of relay 321, conductor 832, left contacts of cam 849, conductor 852, left front contact of relay 302, conductor 349, right contacts of cam 825, conductor 854, left contacts of cam 605 to ground at commutator brush 336. In position 2 the common register connector circuit is seized whereupon sequence switch 800 is advanced to position 4, With zone relay 810 operated and sequence switch 600 in position 13, after sequence switch 800 leaves position 2 only zone relays 914 and 912 and relay 916 will remain operated. Therefore, when sequence switch 800 is advanced to position 5 and relays 1007 and 1011 operate a circuit is established from ground at the left contact of relay 1011 over conductor 1013, contacts of interrupter 918, right front contact of relay 916, outer left front contact of relay 912, outer right contacts of relay 914, right back contact of relay 915, left back contact of relay 927 to battery through the right winding of relay 928. Relays 927, 928 and 929 operate under the control of interrupter 918 causing a single

operation of relay 1015 and a single operation of message register 105. Following the operation of relay 929, sequence switch 800 is advanced to position 7 releasing relays 823 and 827 and releasing the common connector circuit. From position 7 sequence switch 800 is advanced into position 8 in the manner described in connection with a call to zone 5. Since zone relay 810 is operated the previously traced circuit for advancing sequence switch 800 directly in position 12 is effective. Since, however, relay 809 is normal the previously traced circuit for advancing sequence switch 800 directly into position 16 over the upper contacts of cam 847 is open at the contacts of relay 809 and sequence switch 800 is therefore advanced from position 12 into position 18 under the control of the office timing circuit 830 and relays 831 and 305 in the manner previously described, to measure off an overtime period of three minutes. Additional overtime periods are charged for in the same manner.

For calls to zone 3 with sequence switch 600 in position 14 and zone relay 810 operated, sequence switch 800 is advanced into position 2 in the manner described for calls to zone 5, seizing the common register connector circuit whereupon sequence switch 800 is advanced to position 4. In this case when sequence switch 800 leaves position 2 only zone relays 914 and 917 and overtime relay 916 of the connector circuit remain operated. Therefore when sequence switch 800 is advanced to position 5 and relays 1007 and 1011 operate a circuit is established from ground at the left contact of relay 1011 over conductor 1013, contacts of interrupter 918, right front contact of relay 916, inner right front contact of relay 917, outer right front contact of relay 914, conductors 933 and 934, left back contact of relay 915, left back contact of relay 927 to battery through the winding of relay 928. Relays 927, 928 and 929 operate under the control of interrupter 918 causing a single operation of relay 1015 and the message register 105. Following the operation of relay 929 sequence switch 800 is advanced to position 7 releasing relays 823 and 827 and releasing the common connector circuit. From position 7 sequence switch 800 is advanced to position 8 in the manner described in connection with a call to zone 5. Since zone relay 810 is operated, the previously traced circuit for advancing sequence switch 800 directly in position 12 is effective. With sequence switch 800 in position 12 a circuit is now closed from ground at the lower left contact of cam 848, the upper contacts of cam 847, the inner lower back contact of relay 809, conductor 832, outer left front contact of relay 321, conductor 630, upper contacts of cam 618, conductor 822, the lower contacts of cam 819, the lower front contact of relay 810, upper right contact of cam 818 to battery through the winding of sequence switch magnet 800 for advancing the switch into position 16. From position 16 sequence switch 800 is advanced into position 18 under the control of the office timing circuit 830 and relays 821 and 305 in the manner previously described to measure off an overtime period of one minute. Additional overtime periods are charged for and timed in the same manner.

For calls to zone 4, with sequence switch 600 in position 13 and both zone relays 809 and 810 operated, sequence switch 800 is advanced into position 2 in the manner described, in connection with calls into zone 2, seizing the common register connector circuit whereupon sequence switch 800 is advenced in position 4. In this case when sequence switch 800 leaves position 2 zone relays 914, 915 and 912 and overtime relay 916 remain operated. Therefore, when sequence switch 800 is advanced to position 5 and relays 1007 and 1011 operate a circuit is established from ground on conductor 1013, contacts of interrupter 918, right front contact of relay 916, outer left front contact of relay 912, outer right front contact of relay 914, left front contact of relay 915, conductors 930 and 931, left back contact of relay 925 to battery through the right winding of relay 926. Relays 925 to 929 operate under the control of interrupter 918 causing two operations of relay 1015 and two charges on the message register 105. Following the operation of relay 929 sequence switch 800 is advenced to position 7 releasing relays 823 and 827 and releasing the common connector circuit. From position 7 sequence switch 800 is advanced directly into position 16 in the same manner as described for the call to zone 5 and is advanced to position 18 under the control of office timing circuit 830 and relays 305 and 821 to measure off an overtime period of one minute.

From the foregoing discussion the charging and timing of calls to various zones of the exchange area may be recapitulated as indicated in the following table:

Zone	Time limit for initial period	No. of charges for initial period	Time limit for initial overtime periods	No. of charges for overtime periods
0	No limit	None	No limit	0
1	5 minutes	1	5 minutes	1 or none
2	5 minutes	2	3 minutes	1
3	3 minutes	3	1 minute	1
4	3 minutes	4	1 minute	2
5	3 minutes	5	1 minute	2

It will be noted from the foregoing description that the number of charges made for initial and overtime periods and the time intervals allowed for both initial and overtime periods is under the control of the zone relays 809 and 810 and the sequence switch

600 in either position 13 or 14. Thus by altering the connections from the contacts of the zone relays 809 and 810 to contacts of cams of sequence switch 800 and to the zone relays of the common connector circuit, the manner in which the connections are timed and charges made for calls therefore may be altered as required to satisfy traffic regulations imposed by the operating company. If, for example, conductor 930 in the common connector circuit is strapped to conductor 932 rather than to conductor 931, a single charge for overtime periods for all zones will be made rather than the overtime charges indicated in the above table. Also, if the outer right front contact of relay 914 is connected over conductor 933 to conductor 931 rather than to conductor 934, with conductor 930 connected to conductor 931 a single overtime charge will be made for calls to zones 1 and 2 and double charges for calls to zones 3, 4 and 5.

Release of connection

When the calling subscriber hangs up to terminate the call relay 320 releases in turn opening the circuit of relay 301. If the lower contact of interrupter 328 is at the time closed relay 301 will remain locked over its inner left front contact, the lower contact of interrupter 328 to ground at the lower left contact of cam 617 until the interrupter opens its contact. When interrupter 328 again closes its contacts, with relay 301 released, a circuit is established from ground over the lower left contact of cam 617, contacts of interrupter 328, the right back contact of relay 301, the upper left and lower right contacts of cam 613 to battery through the lower winding of relay 316. Relay 316 upon operating locks over its upper winding and inner upper front contact over conductor 812 to ground at the upper left contact of cam 607 and extends this locking ground through the upper winding of relay 330. At its inner upper front contact relay 330 establishes a circuit from ground over conductor 857, the upper contacts of cam 841 to battery through the winding of sequence switch magnet 800 for advancing the timing switch into position 18. Relay 316 also establishes a circuit from battery through the winding of sequence switch magnet 600, upper right contact of cam 608, conductor 634, inner lower front contact of relay 316, conductor 812 to ground at the upper left contact of cam 607 for advancing sequence switch 600 into position 15. Relay 316 at its inner lower back contact removes holding ground from brush 326 but the calling line is held over brush 326, resistance 317, the outer right front contact of relay 325 to ground on conductor 812.

As soon as sequence switch 600 leaves position 14 the holding circuit of relay 302 is opened at the upper left contact of cam 605 and relay 302 releases. After the sequence switch 600 reaches position 15 a circuit is established from battery winding of relay 322, resistance 323, middle right front contact of relay 325, upper contacts of cam 602 to ground over commutator segment 335 and brush 336 whereby relay 322 operates in turn operating relay 329 over a circuit extending from ground at the contact of relay 322, outer left front contact of relay 325 to battery through the upper winding of relay 329. Relay 329 upon operating extends its operating ground over its middle upper front contact to battery through the winding of relay 338 thereby causing the operation of relay 338. Relay 338 at its middle left front contact establishes a holding circuit through the lower winding of relay 329, at its inner right and inner left front contacts connects the winding of relay 322 to the tip and ring conductors of the calling line over line finder brushes 334 and 331 and establishes a circuit for operating relay 302, extending through the winding of relay 302, the outer right front contact of relay 338 to ground at the lower contacts of cam 607. Relay 302 upon operating advances sequence switch 600 into position 16 over a circuit extending from battery through the winding of magnet 600, upper left contact of cam 612, conductor 620, upper right and lower left contacts of cam 801, conductor 802, inner left front contact of relay 302 to ground at the lower left contact of cam 604.

If no ground exists on either the tip or ring conductors of the calling line, which should be the case since the calling party has hung up, relay 322 will not remain energized after sequence switch 600 advances to position 16 and relays 329 and 338 will therefore release, relay 338 in turn releasing relay 302. A circuit is now closed for advancing timing switch 800 to normal which may be traced from battery winding of magnet 800, upper right contact of cam 818, left contacts of cam 807, conductor 808, left back contact of relay 302 to ground at the lower left contact of cam 604. When sequence switch 800 reaches normal a circuit is established from battery, winding of sequence switch magnet 600, upper left contact of cam 608, left back contact of relay 318, conductor 319, lower contacts of cam 807, conductor 808, left back contact of relay 302 to ground at the lower left contact of cam 604. When sequence switch 600 reaches position 17, relay 302 operates over the left contacts of cam 641, conductor 634, inner lower front contact of relay 316, conductor 812 to ground at the upper left contact of cam 607 and locks over its inner right front contact to ground over the left contacts of cam 605 and commutator brush 336. Relay 302 also establishes a circuit for advancing sequence switch 600 into position 18, extending from battery

winding of magnet 600, upper left contact of cam 612, conductor 620, upper right and lower left contacts of cam 801, conductor 802, inner left front contact of relay 302 to ground at the lower left contact of cam 604. Upon leaving position 17, relays 316, 330, 321 and 325 release and ground is removed from test brush 326 of the line finder, thereby releasing the calling line.

With sequence switch 600 in position 18, a circuit is established from battery through the winding of down drive magnet 337 of the line finder, lower left and upper right contacts of cam 603, inner left front contact of relay 302 to ground at the lower left contact of cam 604. When the line finder reaches normal ground is removed from commutator segment 335, thereby releasing relay 302 and arresting the line finder in normal position. In position 18 of sequence switch 600 a circuit is also established from battery through the winding of down drive magnet 636 of the district selector, lower contacts of cam 609, left back contact of relay 318 to ground at the upper left contact of cam 604 for driving the district selector shaft into normal position, in which position a circuit is established from battery winding of sequence switch magnet 600, lower left contact of cam 612, conductor 642, lower contacts of cam 841, conductor 858, normal commutator segment 637, brush 638 to ground at the upper right contact of cam 617 for advancing sequence switch 600 into normal position. Upon leaving brush 15¼ ground is removed at the upper right contact of cam 606 from test brush 639, thereby initiating the release of succeeding selector switches. All apparatus employed in the connection is now in normal condition.

Alarm and release features of the common message register connector circuit

It will be recalled that when the calling subscriber answered and timing switch 800 advanced to position 2 the common connector circuit was seized and relay 1003 operated and connected ground to one contact of interrupter 1018. Thereafter relay 1001 operated releasing relay 1003 but relays 1005 and 1012 operated maintaining ground connected to the interrupter 1018 over conductor 1021. Upon the closure of the interrupter contacts a circuit is therefore established over the right back contact of relay 1019, the winding of relay 1020 to battery through the right winding of relay 1019. Relay 1020 operates in this circuit but relay 1019 being marginal does not operate at this time. When the interrupter 1018 opens its contacts relay 1019 operates over its two windings in series with relay 1020 and the left front contact of relay 1020 to ground on conductor 1021. When the contacts of interrupter 1018 again close after about three seconds, provided ground is still maintained on conductor 1021 the winding of relay 1020 becomes shunted from ground on conductor 1021 over the left front contact and left winding of relay 1019, winding of relay 1020, inner right front contact of relay 1019, contacts of interrupter 1018 to ground on conductor 1021 and relay 1020 releases but relay 1019 is maintained operated over its right winding and inner right front contact until the contacts of interrupter 1018 again open. With relay 1020 released and relay 1019 operated a circuit is established for relay 1022, extending through the winding of relay 1022, the left back contact of relay 1020, the left front contact of relay 1019 to ground on conductor 1021, relay 1022 locking over its right contact to ground on conductor 1021.

When the contacts of interrupter 1018 again open relay 1019 releases. At the end of three more seconds, making a total of six to nine seconds, relay 1020 operates a second time on closure of the contacts of interrupter 1018. When relay 1019 operates a second time on the next opening of the interrupter contacts a circuit is established from battery, winding of relay 1023, left back contact of relay 1024, outer right front contact of relay 1019, outer right front contact of relay 1020 to ground at the left contact of relay 1022, relay 1023 locking over its left front contact through the winding of relay 1024, conductor 1025 to ground at the left back contact of relay 929. Relay 1024 being shunted does not operate in this locking circuit. At its right front contact relay 1023 establishes a circuit extending from battery through the winding of relay 1002, right back contact of relay 1024, right front contact of relay 1023 to ground at the inner right contact of relay 1020. The foregoing operations take place on the supposition that the circuits have not functioned within a specified time to cause the proper charging for the call and the release of the connector circuit from the associated district and, therefore, when relay 1002 operates it opens conductors 824, 826, 859 and 860, thereby releasing relays 827 and 823 to advance the timing switch 800 beyond the charging position. When relay 1020 releases on the next closure of the interrupter contacts 1018 the shunt is removed from the winding of relay 1024 and it operates in series with relay 1023, relays 1023 and 1024 remained locked to the back contact of relay 929. Relay 1024 at its right back contact opens the circuit of relay 1002. The message register connector circuit should now release unless it is in trouble.

In the event that the connector circuit is not released or in case it sticks on the next call, relays 1020 and 1019 operate and release as before operating relay 1022 at the end of three to six seconds and at the end of six to nine seconds on the second operation

of relays 1020 and 1019 relay 1026 is operated over the left front contact of relay 1024, right front contacts of relays 1029 and 1020 to ground at the left contact of relay 1022, relay 1026, locking over its inner right contact to ground at the contact of release key 1027. Relay 1026 also operates lamp 1028, connects ground to conductor 1029 to operate any desired pilot lamps, connects ground to conductor 1030 for operating any suitable alarms and operates relay 1002. Relay 1002 upon operating opens conductors 824, 856, 859 and 860 to prevent the seizure of the connector circuit by any district selector. When the trouble is cleared the key 1027 is operated releasing relay 1026, thereby restoring the circuit to normal.

In case any of the multi-contact relays 905, 906, 908, 909, etc. fail to release after a connection, ground remains connected over the back contact of relay 911, the outer right contact of relay 1012 to the winding of relay 1007, holding relay 1007 operated, which in turn holds relays 1011 and 1012 operated. With relay 1012 held operated ground is maintained on conductor 1021 for a sufficiently long time to cause the alarm and release circuits above described to become established.

If the operation of relay 1004 or of relay 1002 with relay 1001 operated should fail to remove battery at the right back contact of relay 1004 from conductor 824 or 859, relay 1006 will operate holding relay 1005 operated, thus maintaining ground on conductor 1021 to cause the alarms to be given in the manner described and to operate relay 1002 to disconnect the connector circuit from the associated district circuit. Should relay 911 remain operated on account of the operation of relay 902 due to both relays 900 and 901 being operated or on account of failure of the multi-contact relays to operate after the operation of either relay 900 or 901, it will maintain ground on conductor 1021 to cause the operation of the alarms and the release of the connector circuit as previously described.

In case any of the locking contacts of relays 919 to 926 become crossed so that battery is supplied through a locking winding and locking contact of one of these relays to conductor 1014 with relays 1007 and 1011 deenergized as would be the case when the connector circuit is normal, relay 1031 operates connecting ground to conductor 1021 to bring in the alarms and to operate relay 1002 to hold the connector circuit out of service. Should any of relays 912, 914 to 917 be operated falsely due to grounds on the corresponding conductors of the group 850 leading to district selector circuits, relay 913 is held operated operating relay 1005 which in turn causes the operation of the alarms and the release of the connector circuit as above described. Relay 1005 in turn also operates relay 1001 which makes the connector circuit immediately busy to all district selector circuits. In case conductor 843 becomes falsely grounded relay 1012 operates over the back contacts of relays 1009 and 1011 bringing in the alarm as above described. Should relay 1015 be operated falsely due to a ground on conductor 1016 or on contacts of relays 919 to 929, inclusive, it connects ground to the winding of relay 1005 over the front contact of relay 1015 and the back contact of relay 1031 to cause the operation of the alarms and to hold the connector circuit out of service in the manner previously described. From the foregoing it will appear that any unstandard conditions existing in the connector circuit which would cause false charging will cause alarm circuits to be closed and removal of the connector circuit from service.

The connector circuit of Figs. 9 and 10 is arranged to serve two groups of district selector circuits, a district selector circuit of group A being shown in Figs. 3, 6 and 8, the start circuit therefor, extending over conductor 824 as previously described and the locking circuit over conductor 826. The corresponding start circuit for the B group of district selectors is shown at 859 and extends in the same manner in multiple to windings of start relays of such group corresponding to relay 823. The locking circuit of the B group extends from conductor 860 corresponding to conductor 826 over conductor 861, back contacts of start relays such as 823 of the A group to conductor 826.

When it is desired to remove the A group of link circuits and the corresponding district selectors from service make busy key 214 in the link circuit is operated and the corresponding key 1031 in the connector circuit is operated, thereby establishing a circuit from ground at the lower normal contact of key 204, lower alternate contact of key 214, conductor 1036, contact of key 1031 to battery through the winding of relay 1000. Relay 1000 locks to ground on conductor 1036, at its left back contact opens the start conductor 824, at its outer right back contact, opens the locking conductor 826 and at its outer right front contact bridges the locking conductor of the B group of district selector circuits to the winding of relay 1004 so that a district selector in the B group may continue to seize the connector circuit. When it is desired to remove the B group of link circuits and district selectors from service the make busy key 204 and the corresponding key 1033 are operated and a circuit is established from ground at the inner lower normal contact of key 214, lower alternate contact of key 204, conductor 1034, contact of key 1033 to battery through the winding of relay 1035. Relay 1035 operates and locks direct to ground on conductor 1034 and at its right contacts

opens the start conductor 859 and the holding circuit over conductor 860.

What is claimed is:

1. In a telephone exchange system having a plurality of traffic zones, a plurality of telephone lines, a plurality of substations on each line, a message register for each substation, a plurality of selectors, means including one of said selectors for establishing a connection under the control of a substation of one of said lines, a message register connector circuit common to said selectors, means for recording in said connector circuit the zone of the exchange into which the connection is extended, means operative upon the establishment of a connection for rendering said connector circuit individual to said selector, and means controlled by said connector circuit for operating the message register of the calling line substation variably in accordance with the setting of said zone recording means.

2. In a telephone exchange system having a plurality of traffic zones, a plurality of telephone lines, a plurality of correspondingly designated substations on each line, a message register for each substation of each line, a single message register terminal for each line, a plurality of selectors, means including one of said selectors for establishing a connection under the control of a substation on one of said lines, a message register connector circuit common to said selectors, means for recording in said connector circuit the zone of the exchange into which the connection is extended, means operative upon the establishment of a connection for connecting said connector circuit with said selector, said connecting means being effective to render said connector circuit individual to the selector to which it is connected, a set of relays in said connector circuit for each designation of said substations, said relays serving to connect the message registers of similarly designated substations with the message register terminal of the line on which each substation is located, means for operating the set of relays for the desgination of the calling substation, and means controlled by the said connector circuit for variably applying operating current to the message register terminal of the calling line in accordance with the setting of said zone recording means.

3. In a telephone exchange system, having a plurality of traffic zones, a plurality of telephone lines each having a plurality of substations thereon, a message register for each substation on each line, a single message register terminal for each line, a plurality of selectors, means responsive to the extension of a connection from a substation of a line through one of said selectors for testing said line and establishing a record in said selector of the calling substation, a message register connector circuit, means for recording in said connector circuit the zone of the exchange into which the connection is extended, means operative upon the establishment of a connection for associating said connector circuit with said selector, means in said connector circuit responsive to the record in the selector for connecting the corresponding message registers of all the lines which have access to said selector to the message register terminals of the lines to which the message registers are individual, and means jointly under the control of said zone recording means and said selector to variably operate the message register of the calling substation.

4. In a telephone exchange system, having a plurality of traffic zones, a plurality of telephone lines each having a plurality of subscribers' substations thereon, a message register for each substation on each line, a single message register terminal for each line, a plurality of selectors, means responsive to the extension of a connection from a substation of a line through one of said selectors for testing said line and for establishing a record in said selector of the calling substation, a message register connector circuit, means for recording in said connector circuit the zone of the exchange into which the connection is established, means operative upon the establishment of a connection for associating said connector circuit with said selector, a relay in said connector circuit for all corresponding substations, means to operate one of said relays in accordance with the registration in said selector, means under the control of said relays to connect the corresponding message registers of all lines which have access to said selector with the message register terminals of the lines to which the message registers are individual, and means jointly under the control of said zone recording means and said selector to variably operate the message register of the calling substation.

5. In a telephone exchange system, a plurality of telephone lines, a plurality of substations on each line, a message register for each substation, a plurality of selectors, means for establishing a connection under the control of a substation on one of said lines including one of said selectors, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means operative upon the establishment of a connection through one of said selectors for starting the associated timing switch for seizing said connector circuit, means controlled by said connector circuit for operating the message register of the substation of the calling line, and means for thereafter advancing said timing switch to dismiss said connector circuit and to measure a predetermined period for conversation.

6. In a telephone exchange system having a plurality of traffic zones, a plurality of

telephone lines, a plurality of substations on each line, a message register for each substation, a plurality of selectors, means for establishing a connection under the control of a substation on one of said lines including one of said selectors, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means in said connector circuit for recording the traffic zone into which a connection is established, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means for thereafter operating said zone recording means, means controlled by said connector circuit for operating the message register of the substation of the calling line in accordance with the zone recorded, and means for thereafter advancing said timing switch to dismiss said connector circuit and to measure a predetermined period for conversation.

7. In a telephone exchange system having a plurality of traffic zones, a plurality of telephone lines, a plurality of substations on each line, a message register for each substation, a plurality of selectors, means for establishing a connection under the control of a substation on one of said lines including one of said selectors, a timing switch individual to each of said selectors, zone recording means associated with said timing switch for recording the traffic zone into which a connection is established, a message register connector circuit common to said selectors, means in said connector circuit for recording traffic zones, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means for thereafter transferring said zone record from said timing switch to said connector circuit, means controlled by said connector circuit for operating the message register of the substation of the calling line in accordance with the zone recorded, and means for thereafter advancing said timing switch to dismiss said connector circuit and to measure a predetermined period for conversation.

8. In a telephone exchange system having a plurality of traffic zones, a plurality of telephone lines, a message register for each line, a plurality of selectors, means for establishing a connection under the control of a line including one of said selectors, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means in said connector circuit for recording the traffic zone into which a connection is established, means operative upon the establishment of a connection for starting the associated timing switch for seizing said connector circuit, means for thereafter operating said zone recording means, means controlled by said connector circuit for operating the message register of the calling line in accordance with the zone recorded, means for thereafter advancing said timing switch to dismiss said control circuit and to measure a predetermined period for conversation, and means for operating said timing switch and connector circuit through additional cycles to reoperate the message register of the calling line if the connection is maintained.

9. In a telephone exchange system, a plurality of telephone lines, a message register for each line, a plurality of selectors, means for establishing a connection under the control of a line including one of said selectors, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means operative upon the establishment of a connection for starting the associated timing switch for seizing said connector circuit, means controlled by said connector circuit for operating the message register of the calling line, means for thereafter advancing said timing switch to dismiss said connector circuit and to measure a predetermined period for conversation, and means for operating said timing switch and connector circuit through additional cycles to reoperate the message register of the calling line if the connection is maintained.

10. In a telephone exchange system, telephone lines each having a plurality of subscribers' substations located thereon, a message register for each substation, a single message register terminal for each line, a plurality of selectors for extending said line, means responsive to the extension of a connection from one of said substations through one of said selectors for testing said line and for establishing a record in the selector of the substation calling, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means operative upon the establishment of a connection for starting the associated timing switch for seizing said connector circuit, means in said connector circuit responsive to the recording means in the selector for connecting the corresponding party message registers of the lines which have access to said selector to the register terminals of the corresponding lines, means under the joint control of the connector circuit and said selector to operate the message register of the calling party, means for thereafter advancing said timing switch to dismiss said connector circuit and to measure an initial period for conversation and means for operating said timing switch and connector circuit through additional cycles to reoperate the message register of the calling line party if the connection is maintained.

11. In a telephone exchange system having a plurality of traffic zones, telephone lines each having a plurality of subscribers' substations located thereon, a message register for each substation, a single message register

terminal for each line, a plurality of selectors for extending said line, means responsive to a connection from one of said substations through one of said selectors for testing said line and for establishing a record in the selector of the substation calling, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means in said connector circuit for recording the traffic zone into which a connection is established, means operative upon the establishment of a connection for starting the associated timing switch for seizing said connector circuit, means for thereafter operating said zone recording means, means in said connector circuit responsive to the recording means in said selector for connecting the corresponding party message registers of the line which have access to said selector to the register terminals of the corresponding lines, means under the joint control of the connector circuit and said selector to operate the message register of the calling party in accordance with the zone recorded, means for thereafter advancing said timing switch to dismiss said connector circuit and to measure an initial period for conversation, and means for operating said timing switch and connector circuit through additional cycles to reoperate the message register of the calling line party if the connection is maintained.

12. In a telephone exchange system having a plurality of traffic zones, a plurality of telephone lines, a plurality of substations on each line, a message register for each substation, a plurality of selectors, means for establishing a connection under the control of a substation on one of said lines including one of said selectors, a timing switch individual to each of said selectors, means in said timing switch for recording the traffic zone into which a connection is established, a message register connector circuit common to said selectors, means in said connector circuit for recording traffic zones, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means for thereafter transferring said zone record from said timing switch to said connector circuit, means controlled by said connector circuit for operating the message register of the substation of the calling line in accordance with the zone recorded, and means for thereafter advancing said timing switch to dismiss said connector circuit and to measure a predetermined period of conversation in accordance with the zone recorded in said timing switch.

13. A telephone exchange system having a plurality of traffic zones, a plurality of telephone lines, a plurality of substations on each line, a message register for each substation, a plurality of selectors, means for establishing a connection under the control of a substation on one of said lines including one of said selectors, a timing switch individual to each of said selectors, means in said timing switch for recording the traffic zone into which a connection is established, a message register connector circuit common to said selectors, means in said connector circuit for recording traffic zones, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means for thereafter transferring said zone record from said timing switch to said connector circuit, means controlled by said connector circuit for operating the message register of the substation of the calling line in accordance with the zone recorded, means for thereafter advancing said timing switch to dismiss said connector circuit and to measure off an initial period for conversation in accordance with the zone recorded in said timing switch, and means for operating said timing switch and connector circuit through additional cycles to reoperate the message register of the calling substation if the connection is maintained.

14. A telephone exchange system having a plurality of traffic zones, a plurality of telephone lines, a plurality of substations on each line, a message register for each substation, a plurality of selectors, means for establishing a connection under the control of a substation on one of said lines including one of said selectors, a timing switch individual to each of said selectors, means in said timing switch for recording the traffic zone into which a connection is established, a message register connector circuit common to said selectors, means in said connector circuit for recording traffic zones, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means for thereafter transferring said zone record from said timing switch to said connector circuit, means controlled by said connector circuit for operating the message register of the substation of the calling line in accordance with the zone recorded, means for thereafter advancing said timing switch to dismiss said connector circuit and to measure off an initial period for conversation in accordance with the zone recorded in said timing switch, means operated at the expiration of said initial period of said connection is maintained to record an over-time condition, and means for thereafter operating said timing switch and connector circuit through additional cycles to reoperate the message register of the calling substation in a different manner in accordance with the zone recorded and to measure off an overtime period for conversation different from the corresponding initial period in accordance with the zone recorded.

15. A telephone exchange system having a plurality of traffic zones, a plurality of tele-

phone lines, a plurality of substations on each line, a message register for each substation, a plurality of selectors, means for establishing a connection under the control of a substation on one of said lines including one of said selectors, a timing switch individual to each of said selectors, means in said timing switch for recording the traffic zone into which a connection is established, a message register connector circuit common to said selectors, means in said connector circuit for recording traffic zones, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means for thereafter transferring said zone record from said timing switch to said connector circuit, means controlled by said connector circuit for operating the message register of the substation of the calling line in accordance with the zone recorded, means for thereafter advancing said timing switch to dismiss said connector circuit and to measure off an initial period for conversation in accordance with the zone recorded in said timing switch, means operated at the expiration of said initial period if said connection is maintained to record an overtime condition in said selector, means for thereafter operating said timing switch to again seize said connector circuit and to transfer the zone record and overtime record thereto, and means to operate said timing switch and connector circuit through an additional cycle to reoperate the message register of the calling substation in a different manner in accordance with the zone recorded, and to measure off an overtime period for conversation different from the corresponding initial period in accordance with the zone recorded.

16. In a telephone exchange system, telephone lines each having a plurality of subscribers' substations located thereon, a message register for each substation, a single message register terminal for each line, a plurality of selectors for extending said line, means responsive to the extension of a connection from one of said substations through one of said selectors for testing said line and for establishing a record in the selector of the substation calling, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means in said connector circuit responsive to the recording means in the selector for connecting the corresponding party message registers of the lines which have access to said selector to the register terminals of the corresponding lines, means under the joint control of the connector circuit and said selector to operate the message register of the calling party, means for thereafter advancing said timing switch to measure an initial period for conversation, means operative at the expiration of said initial period if said connection is maintained to record an overtime condition, and means for thereafter operating said timing switch and connector circuit through additional cycles to reoperate the message register of the calling substation in a different manner and to measure off an overtime period for conversation different from the initial period.

17. In a telephone exchange system having a plurality of traffic zones, telephone lines each having a plurality of subscribers' substations, a single message register terminal for each line, a plurality of selectors for extending said line, means responsive to a connection from one of said substations through one of said selectors for testing said line and for establishing a record in the selector of the substation calling, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means in said connector circuit for recording the traffic zone into which a connection is established, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means for thereafter operating said zone recording means, means in said connector circuit responsive to the recording means in said selector for connecting the corresponding party message registers of the lines which have access to said selector to the register terminals on the corresponding lines, means under the joint control of the connector circuit and said selector to operate the message register of the calling party in accordance with the zone recorded, means for thereafter advancing said timing switch to dismiss said connector circuit and to measure off an initial period for conversation, means operative at the expiration of said initial period if said connection is maintained to record an overtime condition, and means for thereafter operating said timing switch and connector circuit through additional cycles to reoperate the message register of the calling substation in a different manner in accordance with the zone recorded and to measure off an overtime period for conversation different from the corresponding initial period in accordance with the zone recorded.

18. In a telephone exchange system having a plurality of traffic zones, a plurality of telephone lines each having a plurality of substations, a message register for each substation of each calling line, a plurality of selectors, means for establishing a connection under the control of one of said lines including one of said selectors, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means in said timing switch for recording the traffic zone

into which a connection is established, means in said connector circuit for recording traffic zones, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means for thereafter transferring said zone record from said timing switch to said connector circuit, means controlled by said connector circuit for operating the message register of the substation of the calling line in accordance with the zone recorded, means for thereafter advancing said timing switch to dismiss said connector circuit and to measure off a predetermined period for conversation in accordance with the zone recorded in said timing switch, and means for preventing the starting of said timing switch and the seizure of said connector circuit if the zone record established indicates a local called zone whereby the calling substation message register is not operated and the duration of the connection is not measured.

19. In a telephone exchange system having a plurality of traffic zones, a plurality of telephone lines each having a plurality of substations, a message register for each substation of a calling line, a plurality of selectors, means for establishing a connection under the control of one of said lines including one of said selectors, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means in said timing switch for recording the traffic zones into which a connection is established, means in said connector circuit for recording traffic zones, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means for thereafter transferring said zone record from said timing switch to said connector circuit, means controlled by said connector circuit for operating the message register of the substation of the calling line in accordance with the zone recorded, means for thereafter advancing said timing switch to dismiss said connector circuit and to measure off a predetermined period for conversation in accordance with the zone recorded in said timing switch, and means to render said connector circuit unselectable by a timing switch if unstandard conditions exist therein which would cause false operations of a calling substation message register.

20. In a telephone exchange system having a plurality of traffic zones, a plurality of telephone lines each having a plurality of substations, a message register for each substation of a calling line, a plurality of selectors, means for establishing a connection under the control of one of said lines including one of said selectors, a timing switch individual to each of said selectors, a message register connector circuit common to said selectors, means in said timing switch for recording the traffic zones into which a connection is established, means in said connector circuit for recording traffic zones, means operative upon the establishment of a connection for starting the associated timing switch to seize said connector circuit, means for thereafter transferring said zone record from said timing switch to said connector circuit, means controlled by said connector circuit for operating the message register of the substation of the calling line in acordance with the zone recorded, means for thereafter advancing said timing switch to dismiss said connector circuit and to measure off a predetermined period for conversation in accordance with the zone recorded in said timing switch, means to render said connector circuit unselectable by a timing switch if unstandard conditions exist therein which would cause false operations of a calling substation message register, and signal means to indicate the existence of such an unstandard condition.

In witness whereof, we hereunto subscribe our names this 27th day of June, 1930.

LEWIS H. JOHNSON.
EARL S. GIBSON.