

July 11, 1933.

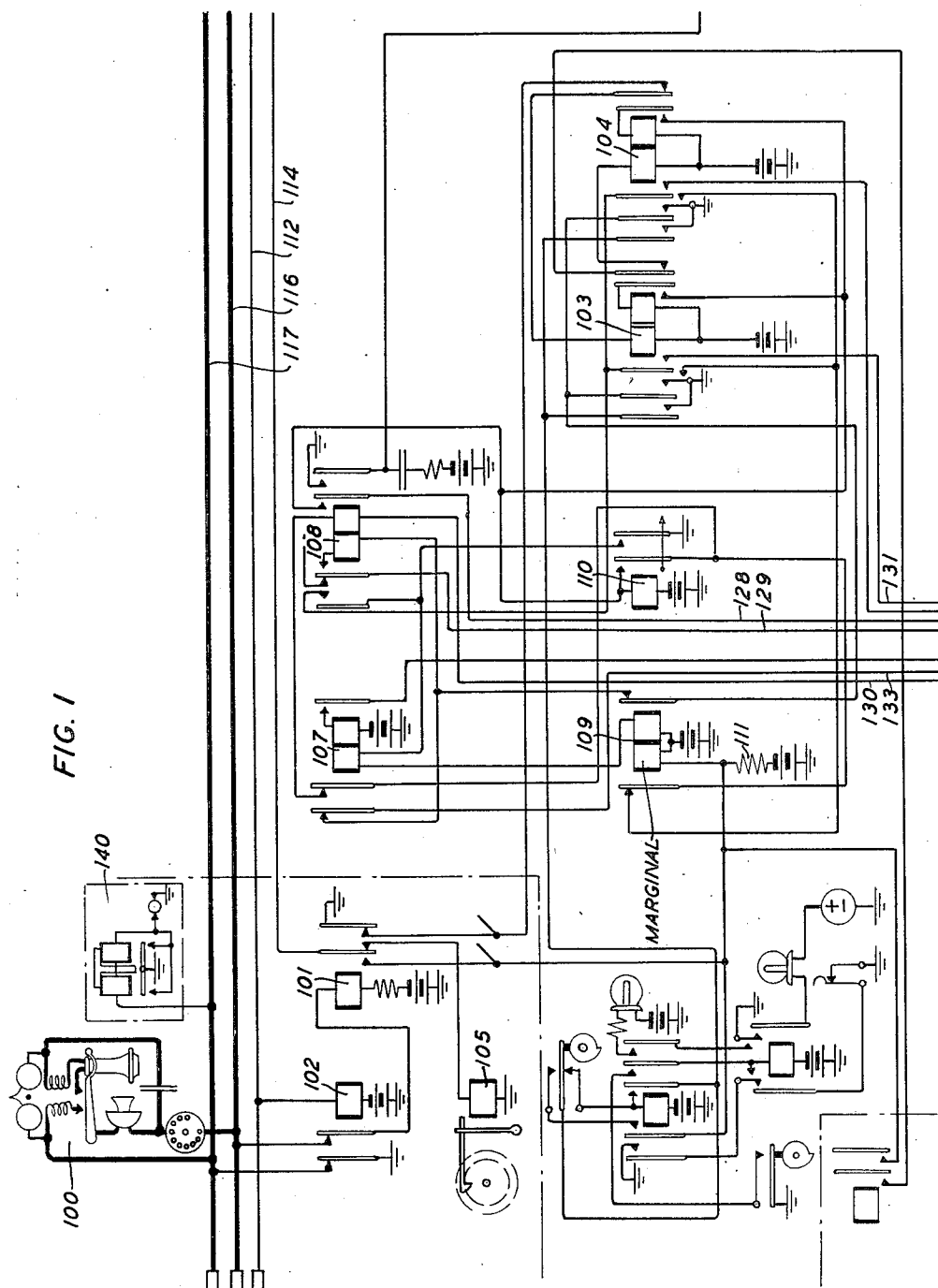
A. E. HAGUE

1,917,884

CALL CHARGING TELEPHONE SYSTEM

Filed March 30, 1932

15 Sheets-Sheet 1



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15 Sheets-Sheet 2

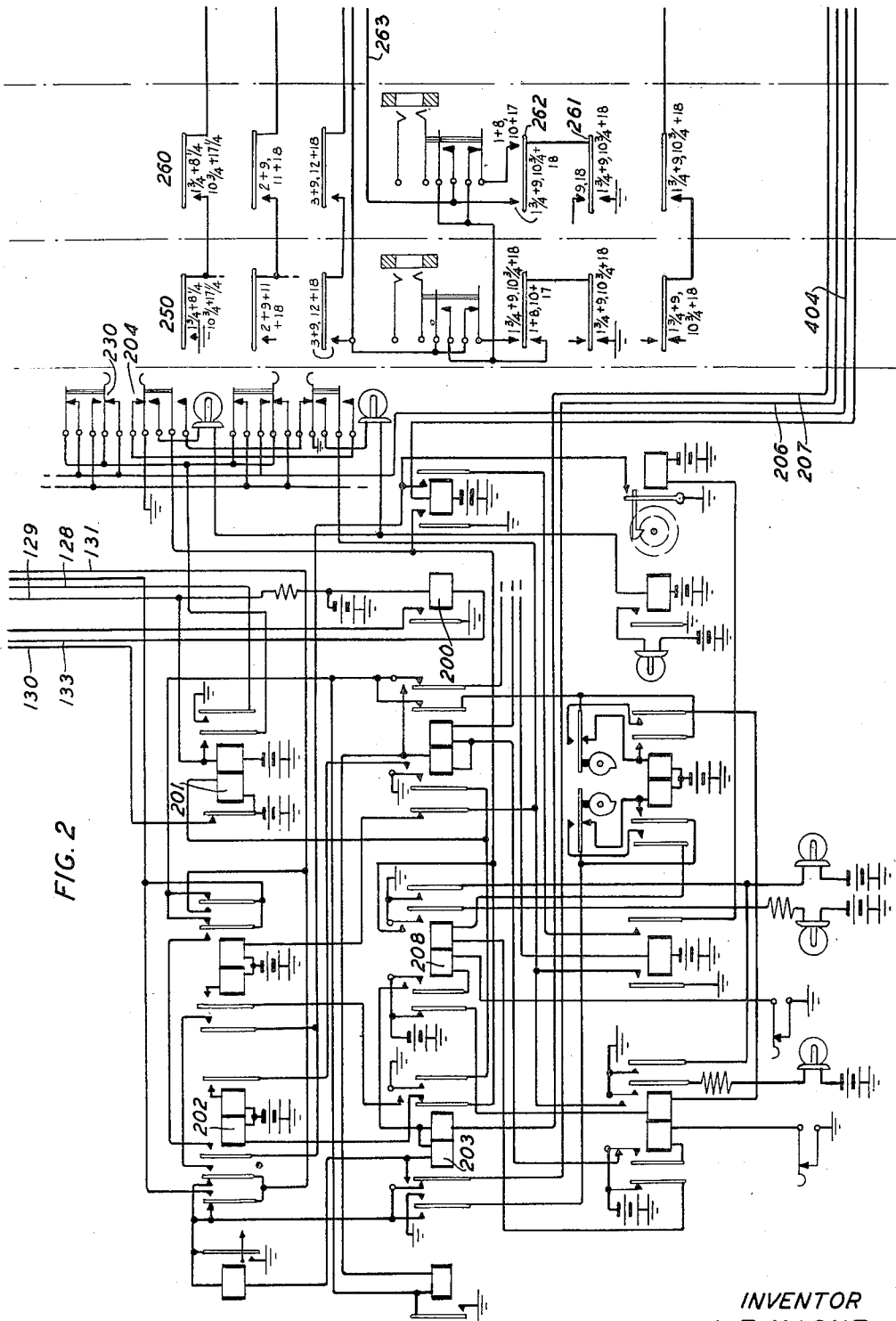


FIG. 2

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15 Sheets-Sheet 3

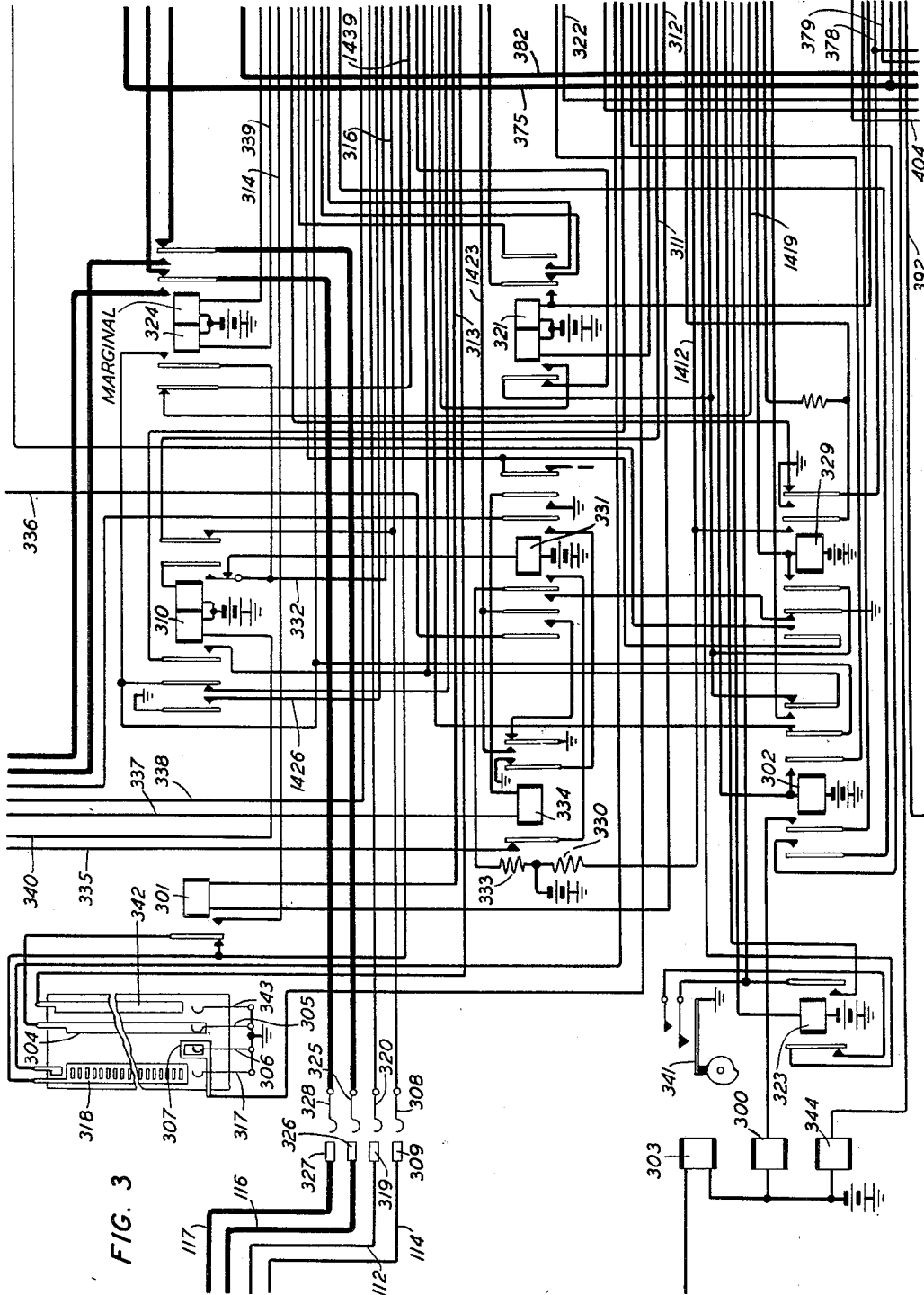


FIG. 3

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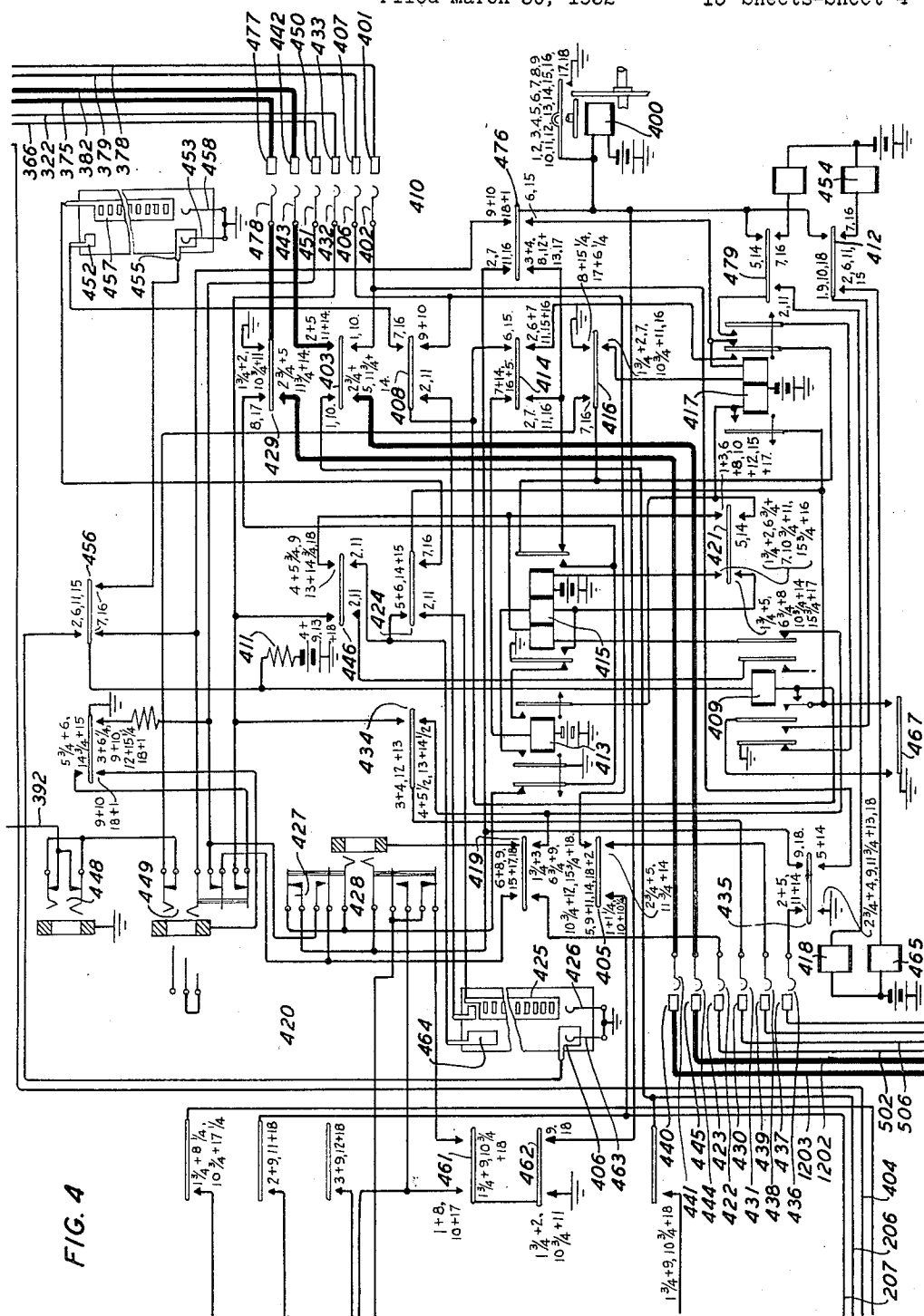
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15 Sheets-Sheet 4



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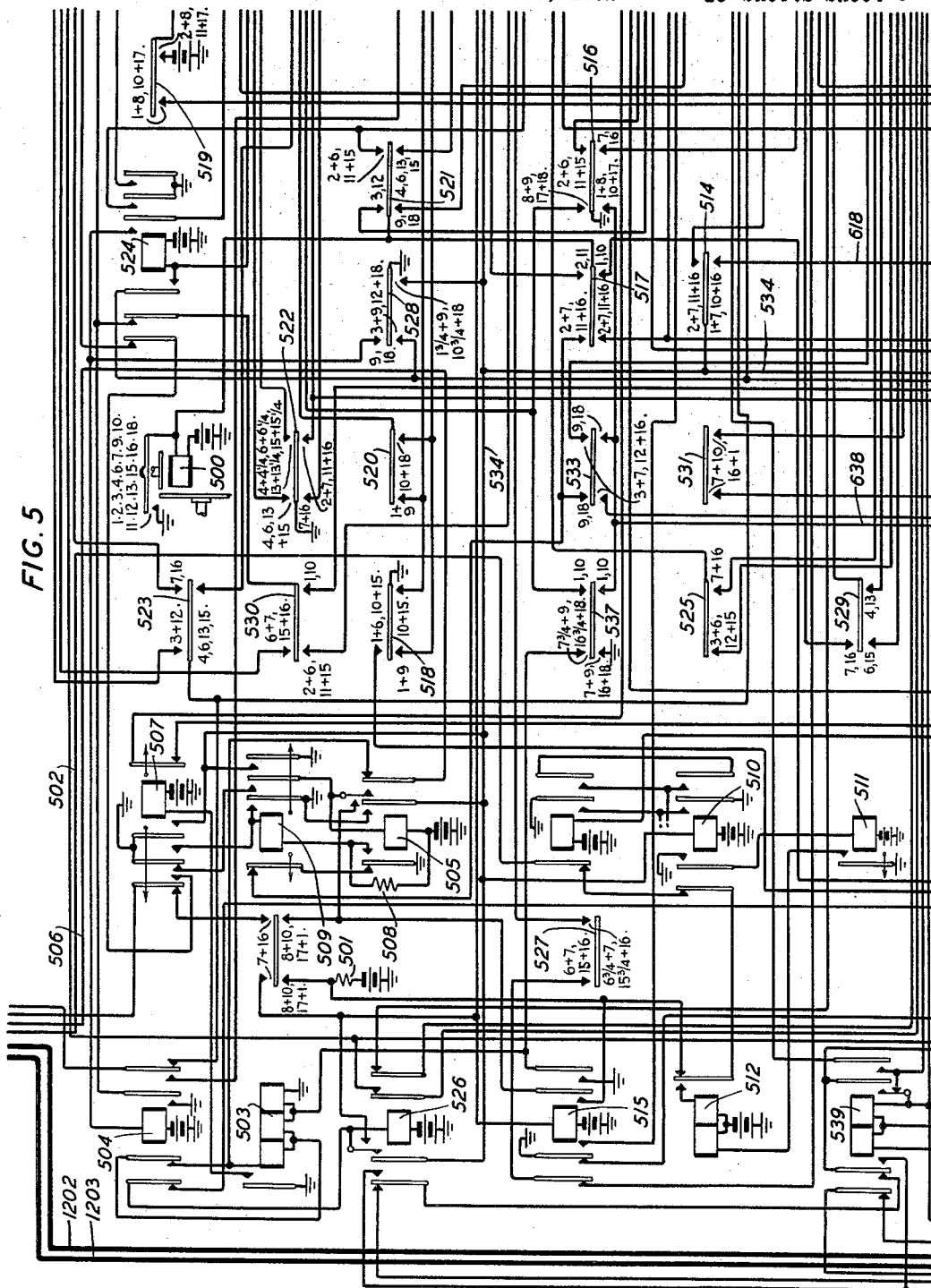
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15 Sheets-Sheet 5



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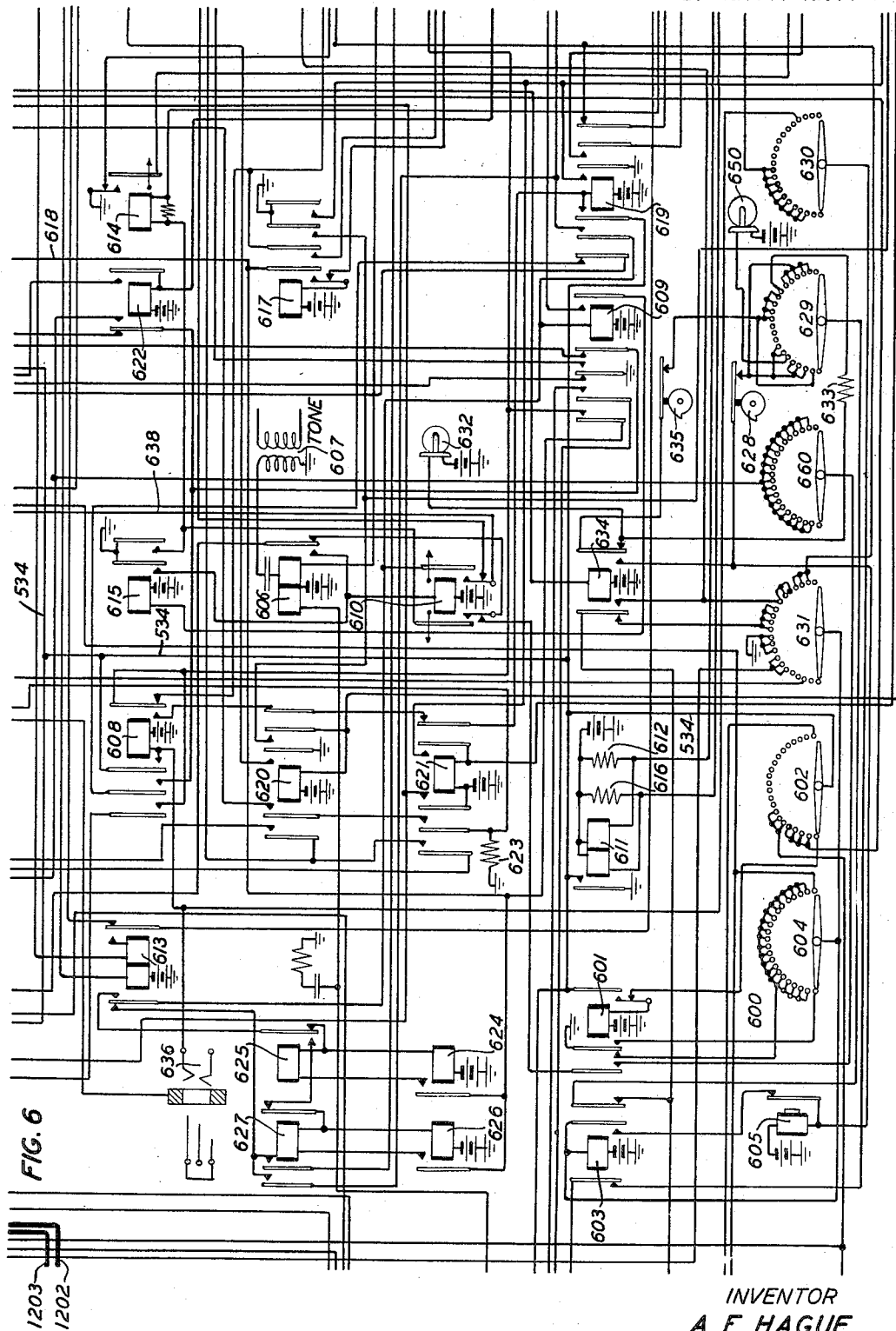
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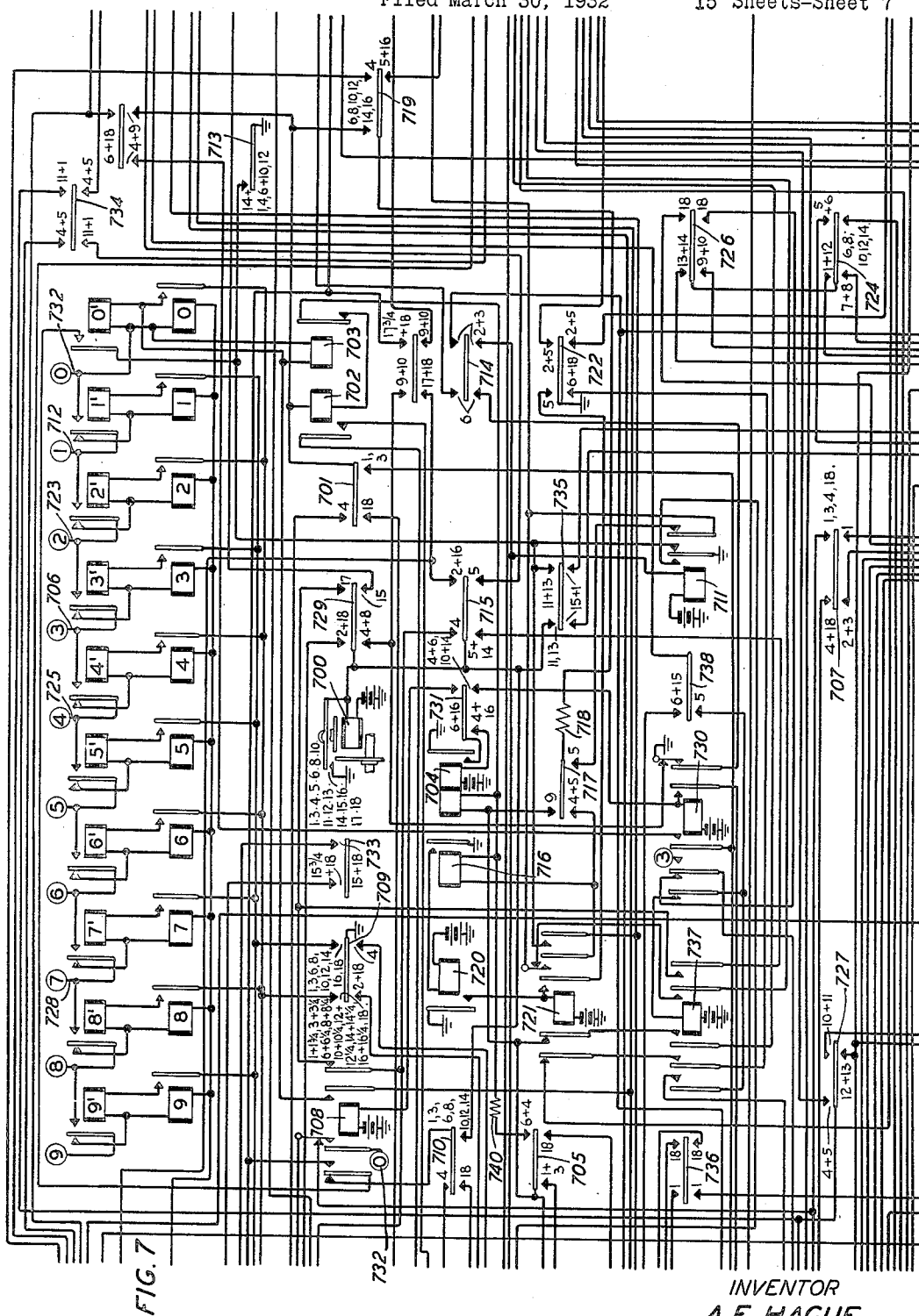
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15 Sheets-Sheet 7



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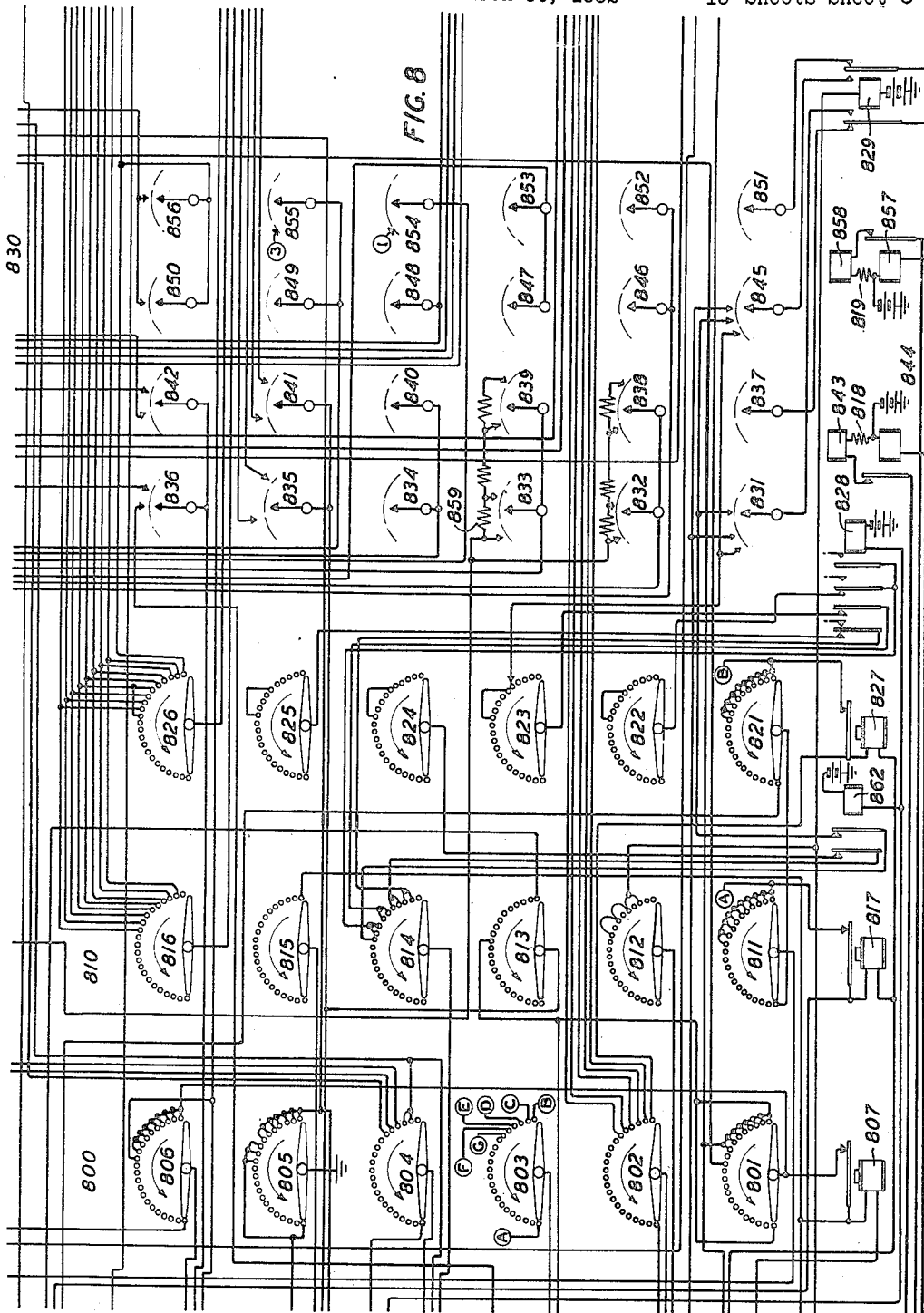
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1,917,884

CALL CHARGING TELEPHONE SYSTEM

Filed March 30, 1932

15 Sheets-Sheet 9

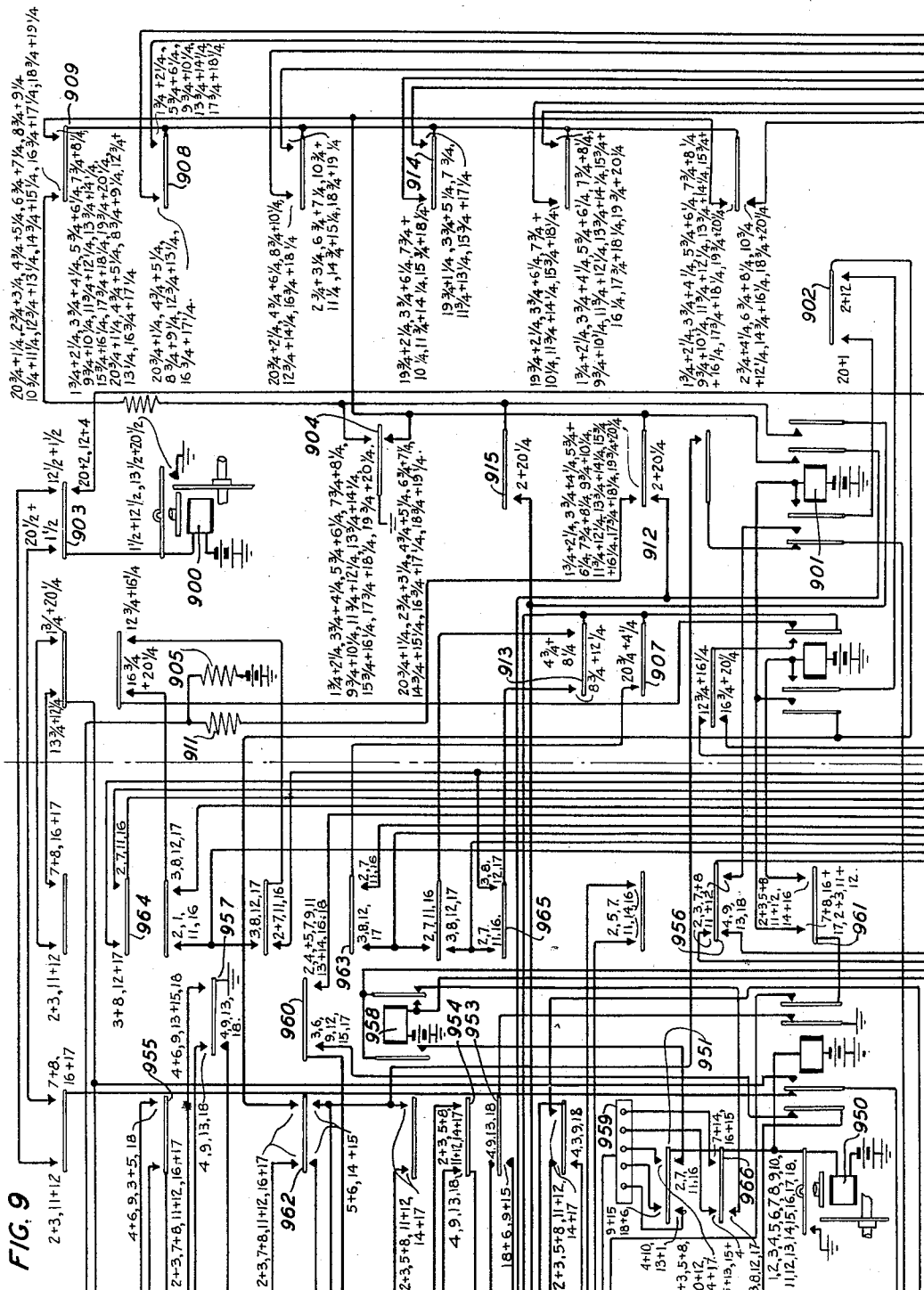


FIG. 9

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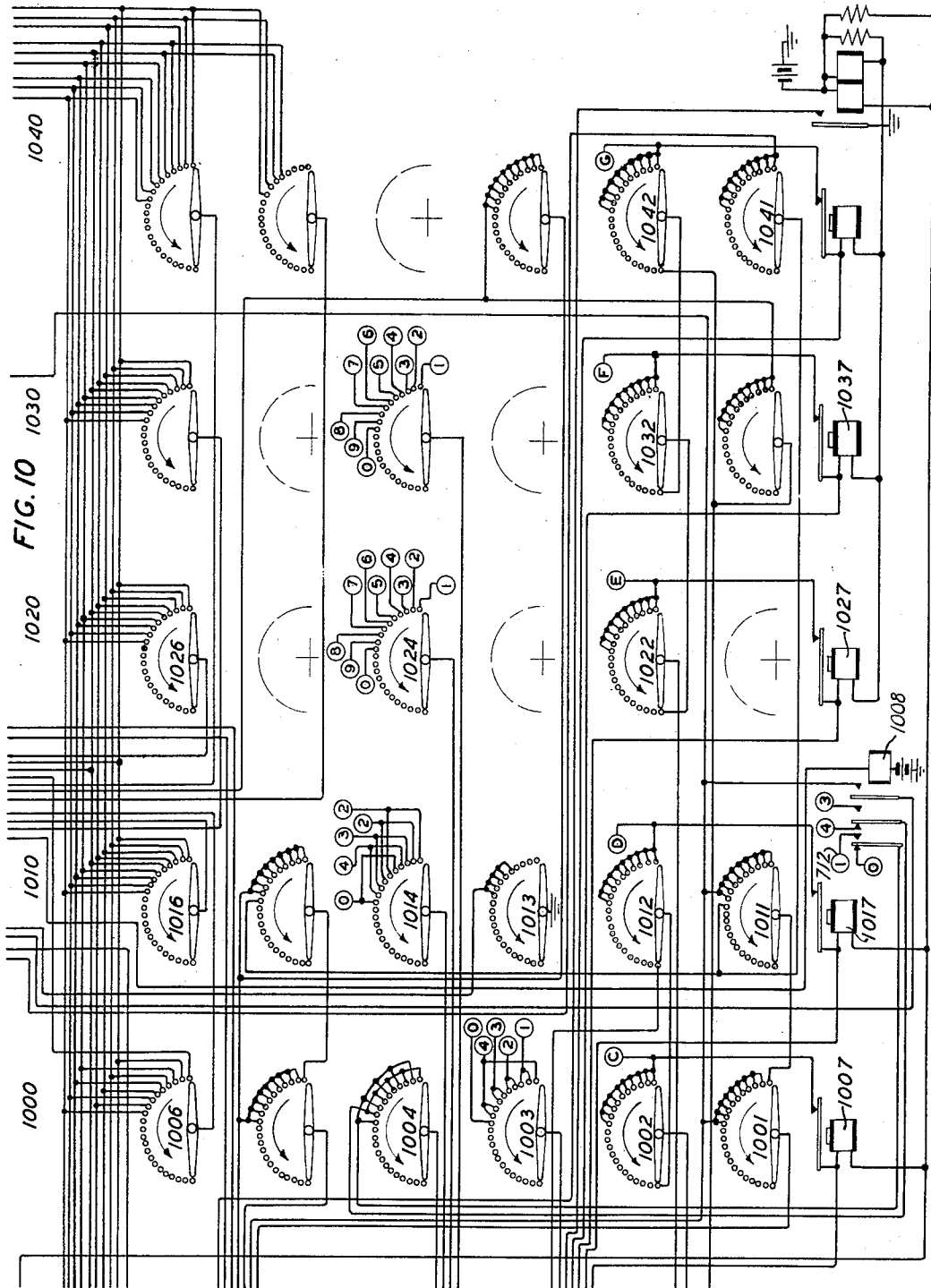
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15 Sheets-Sheet 10



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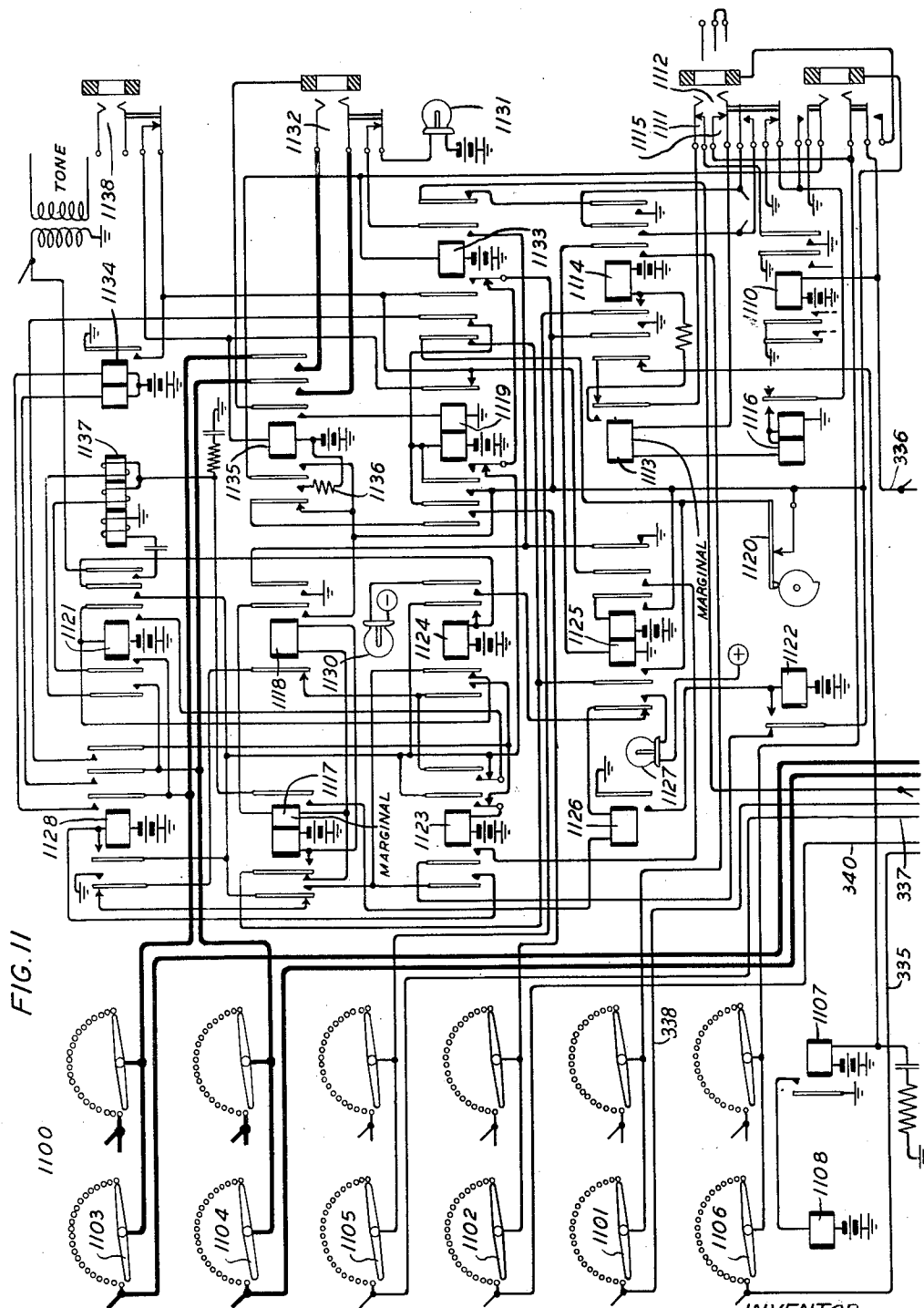
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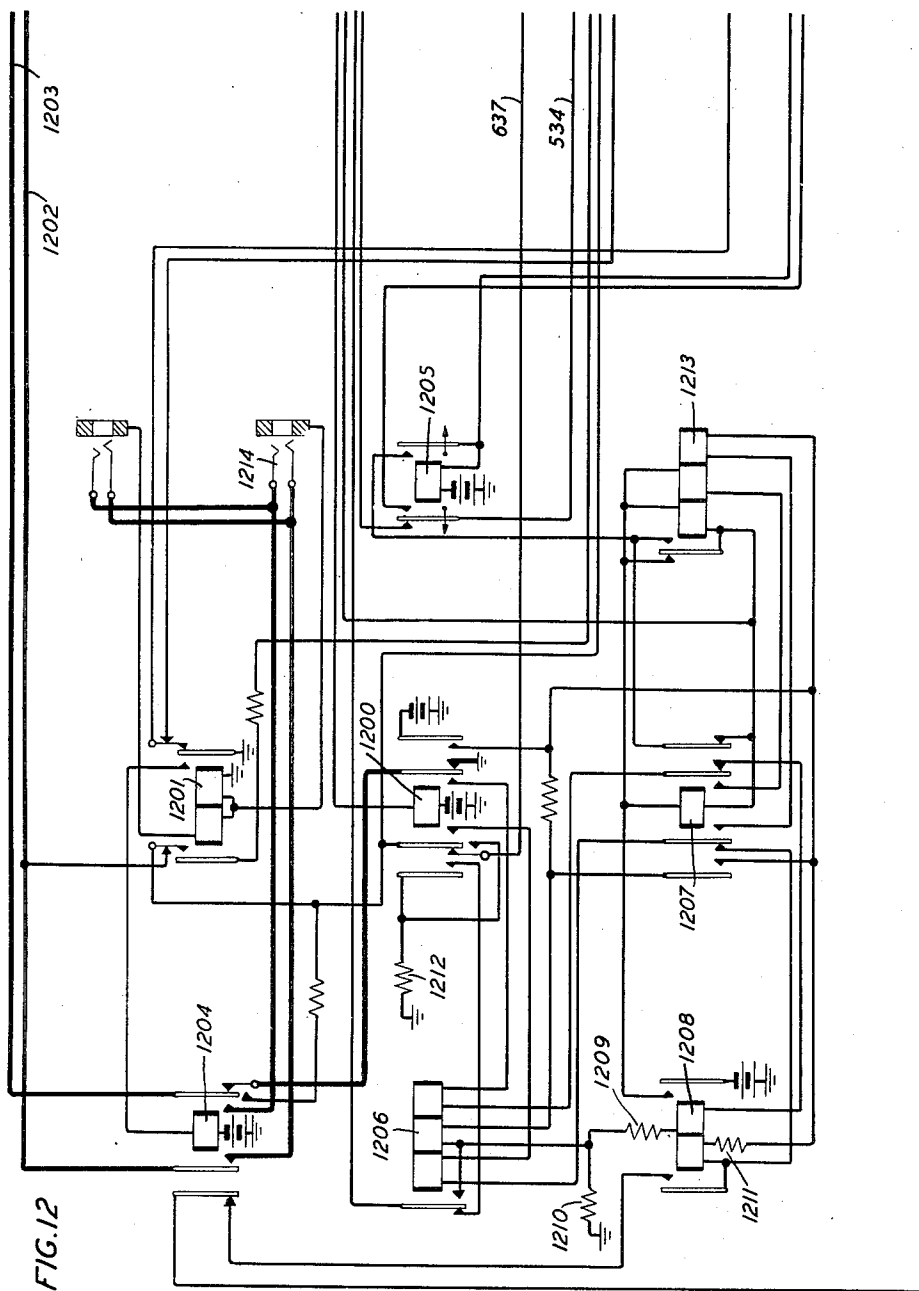
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15 Sheets-Sheet 12



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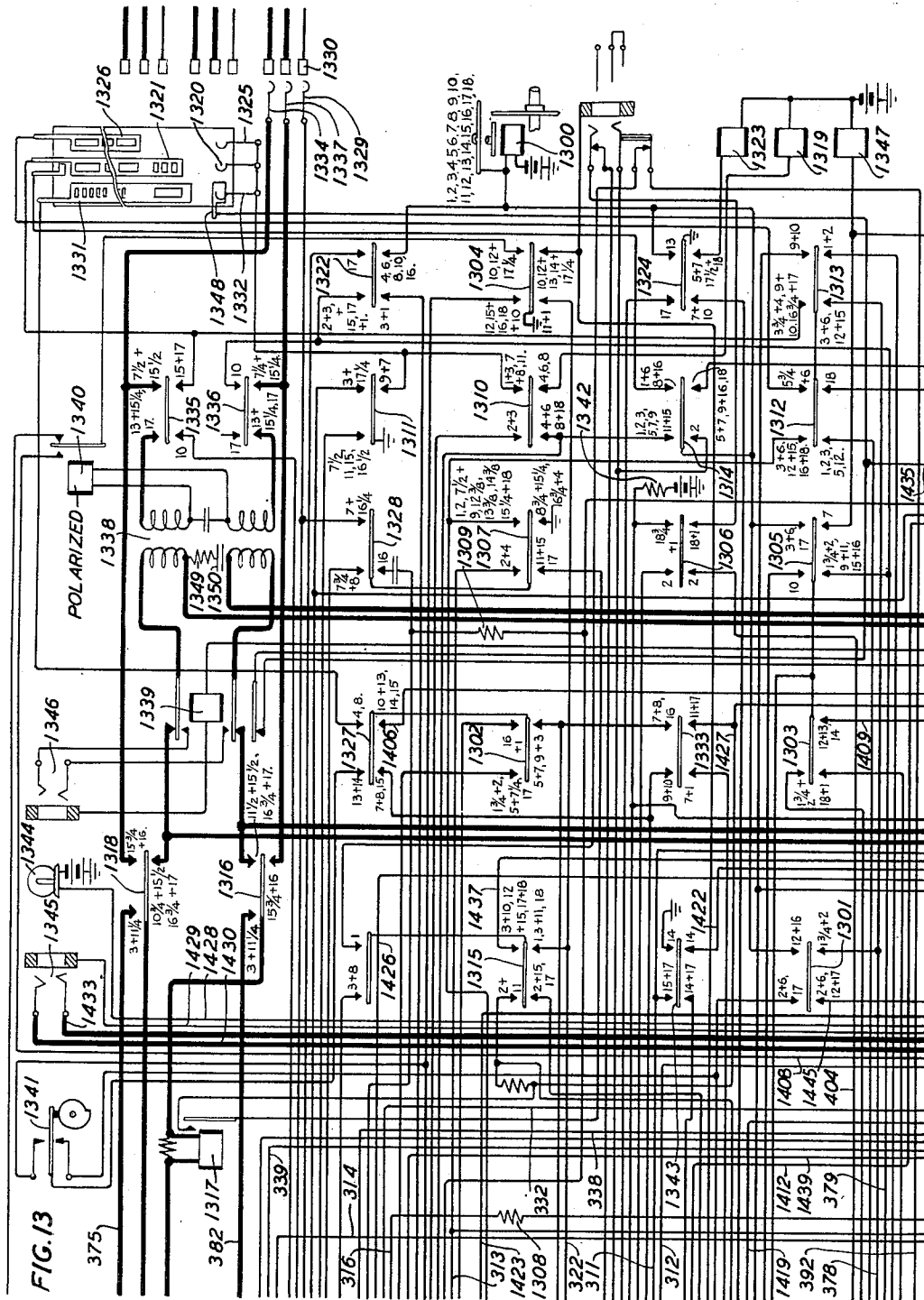
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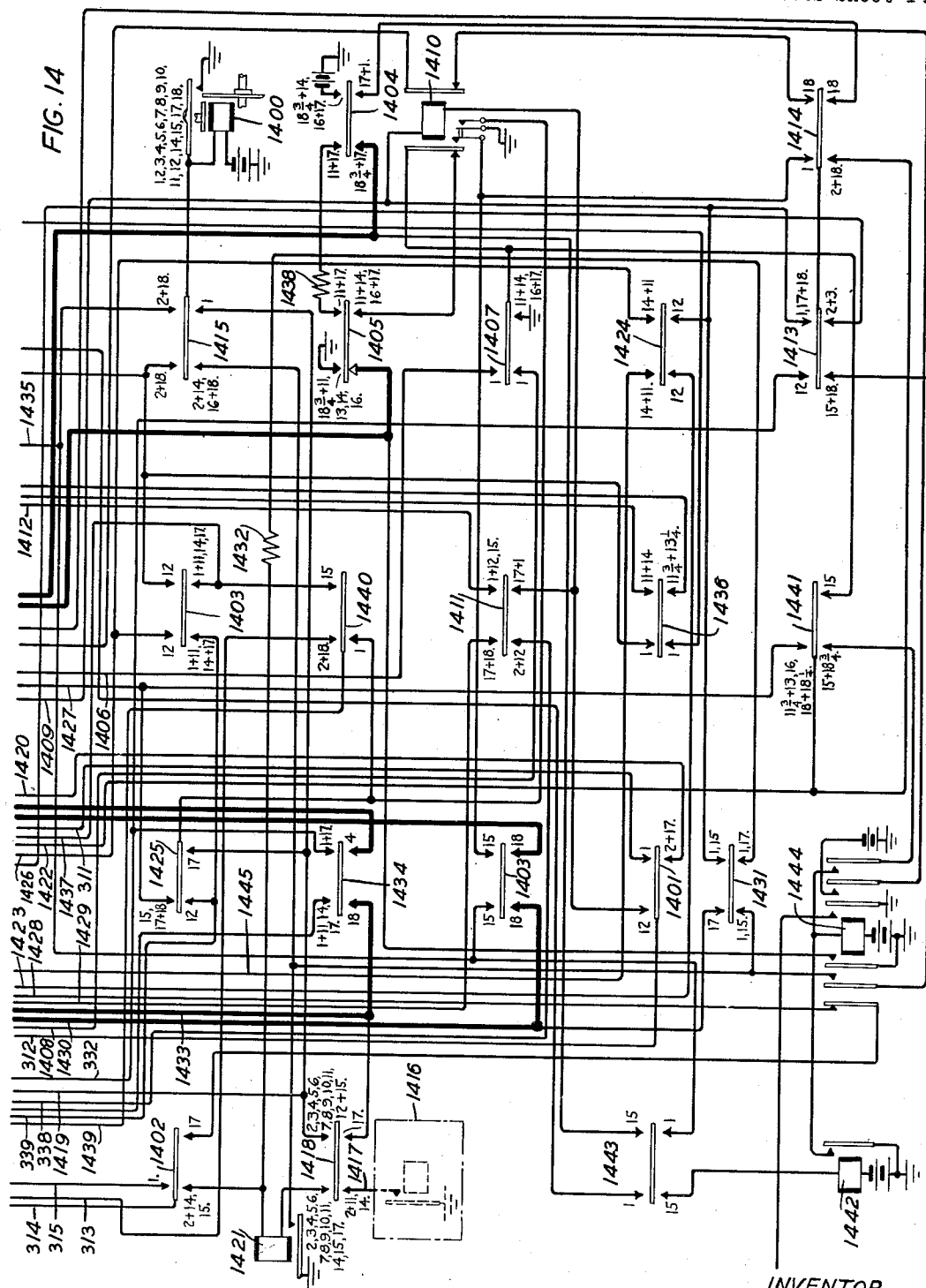
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15 Sheets-Sheet 15

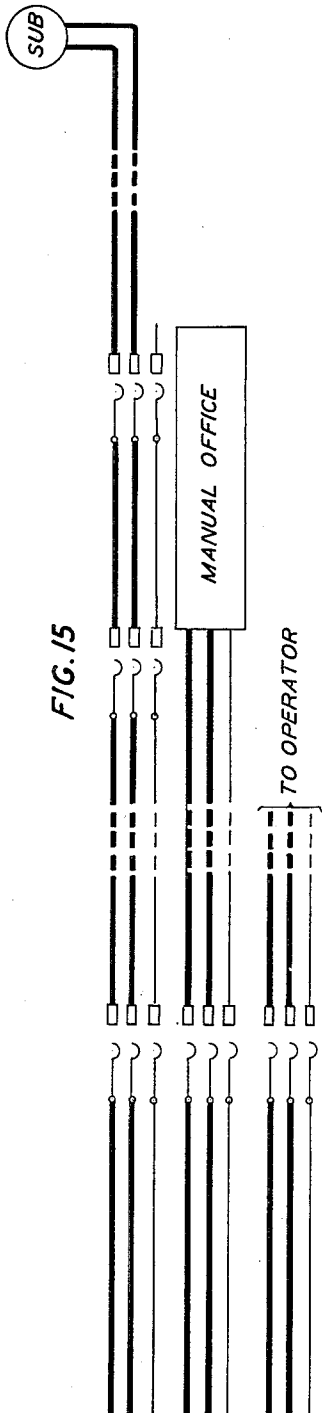


FIG. 16

FIG. 11	FIG. 3	FIG. 13	FIG. 15
FIG. 1	FIG. 2	FIG. 4	FIG. 14
FIG. 12		FIG. 5	FIG. 7
		FIG. 6	FIG. 8
			FIG. 9
			FIG. 10

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UNITED STATES PATENT OFFICE

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CALL CHARGING TELEPHONE SYSTEM

Application filed March 30, 1932. Serial No. 601,986.

This invention relates to telephone exchange systems and more particularly to systems in which automatic switches are employed in the establishment of connections and in which charges are assessed for calls by means of coin boxes associated with sub-

stations of calling lines. An object of the invention is to enable the subscriber to continue conversation over a plurality of unit periods of conversation by supplying him with a warning tone to deposit another coin or token after each period and by automatically collecting the same for each elapsed period without the necessity of calling in a monitoring operator to perform either or both of these functions.

It has been found, however, that monitoring service is costly in that it requires the services of a considerable number of operators and also because it adds to the holding time of the connection. The present invention, therefore, has for its object the elimination of this monitoring service by providing a warning tone to the subscriber near the end of the conversation period simultaneously with the automatic collection of the coin and the undisturbed continuation of the conversation thereafter if another coin is deposited. In accordance with the present invention this desirable function has been incorporated in circuits which are in some respects similar to the circuits disclosed in the aforementioned patent to A. E. Hague. Every line finder district link is provided, therefore, with a timing switch which is started upon the response of the called subscriber and advances through a cycle to measure the prescribed unit period for conversation. Common to a group of line finder district links, a plurality of coin box control circuits is provided, each equipped with apparatus for either applying coin collecting or coin refunding current to the coin box of the calling line, and each having individual thereto a hunting switch for associating the control circuit with a line finder district selector link circuit.

The methods of controlling coin collection above referred to, however, make provision for charging for an associated connection only on the basis of a single charge for the period of conversation. In order, however, that for extended conversations the operating company may be more equitably compensated for the prolonged use of its equipment, it is desirable that the initial period of conversation for a single charge be automatically timed and limited and, if the conversation continues beyond this limit, an additional coin should be requested and col-

lection. A circuit of this character is disclosed in the Patent 1,823,040, issued September 15, 1931 to A. E. Hague, wherein a coin monitoring operator is brought in on the established connection after the initial period of conversation and the calling subscriber apprised that an additional coin or token is required to preserve the established connection for an additional period of conversation. It has been found, however, that monitoring service is costly in that it requires the services of a considerable number of operators and also because it adds to the holding time of the connection. The present invention, therefore, has for its object the elimination of this monitoring service by providing a warning tone to the subscriber near the end of the conversation period simultaneously with the automatic collection of the coin and the undisturbed continuation of the conversation thereafter if another coin is deposited. In accordance with the present invention this desirable function has been incorporated in circuits which are in some respects similar to the circuits disclosed in the aforementioned patent to A. E. Hague. Every line finder district link is provided, therefore, with a timing switch which is started upon the response of the called subscriber and advances through a cycle to measure the prescribed unit period for conversation. Common to a group of line finder district links, a plurality of coin box control circuits is provided, each equipped with apparatus for either applying coin collecting or coin refunding current to the coin box of the calling line, and each having individual thereto a hunting switch for associating the control circuit with a line finder district selector link circuit.

The timing circuit is arranged to close a start circuit for all idle coin control switches just prior to the completion of its timing cycle for causing the association of an idle control circuit with the link. The first idle control circuit switch to find the link is arrested to seize the link and the other hunting switches of other control circuits are also arrested. Upon the association of the control circuit with the link, the calling line is disconnected

from the repeating coil of the district link and connected to the control circuit whereby coin collecting current is transmitted from the coin control circuit to the coin box of the calling line for collecting the deposited coin. At the same time, however, a warning tone is superimposed upon the coin battery, which tone is transmitted over the calling line to the subscriber's instrument for the purpose of apprising him that the period of conversation is terminated and that another coin is required before conversation may be resumed. A small interval of time is now measured by a simple timing circuit for giving the subscriber an opportunity to deposit another coin. At the end of this period a test is made by the timing circuit to determine whether or not the subscriber has deposited another coin. If the test indicates that the subscriber has deposited the coin, the talking connection, which was momentarily disrupted, is reestablished and the subscribers are permitted to continue their conversation. Should the test, however, indicate that the subscriber has not deposited another coin but is still on the line, the timing switch of the link causes a lamp to be lighted at an operator's position to inform her that the subscriber has failed to deposit another coin as suggested to him by the warning tone. The operator thereupon plugs a cord circuit into a jack of the link for the purpose of determining if the calling subscriber desires to continue the conversation for an additional timed period. If the subscriber intimates that he desires to so continue by depositing an additional coin, the operator then disconnects and the timing switch advances through another cycle again causing the association of a control circuit with the link for the collection of the deposited coin, supplying warning tone to the subscriber and testing again for the presence of an additional coin for an additional over-time period and upon failure to deposit said coin again bringing in the monitoring operator. The circuits then continue to function in this manner as long as the calling subscriber desires to maintain the connection and deposits a coin for each additional over-time period of conversation. In this manner the number of monitoring operators is considerably reduced in that an operator is now brought in on the connection only if the subscriber fails to deposit the additional coin in response to the warning tone.

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

Fig. 1 shows one of a group of subscribers' lines together with the trip circuit serving the group;

Fig. 2 shows a start circuit serving a plurality of groups of lines;

Figs. 3 and 13 taken together show a line finder district selector link circuit for extending a connection from the calling line, Fig. 3 showing the line finder and Fig. 13 showing the district selector together with a sequence switch for controlling the circuits of the line finder and district selector;

Fig. 4 shows one of a plurality of link circuits serving the subgroup including the calling line 100;

Figs. 5 to 10 inclusive and Fig. 12 show the circuits of a register sender adapted to be selected by the link circuit of Fig. 4 and to control selector switches in their selective movements;

Fig. 11 shows one of a plurality of coin box control circuits embodying, in part, the present invention;

Fig. 14 shows a timing circuit individual to the line finder district selector link circuit of Figs. 3 and 13;

Fig. 15 shows in diagrammatic form the switches necessary to establish connections from the district selector of Fig. 13, and

Fig. 16 is a diagram showing the manner in which the several figures of the drawing should be arranged to show the complete circuits of the invention.

Subscribers' lines, such as line 100, are connected to multiple terminals appearing before a plurality of line finders. These multiple terminals are arranged in a plurality of groups, each group being served by a separate brush-set on each finder and each group being divided into two subgroups. A trip circuit is provided individual to each group; a start circuit is provided for all the groups of lines served by the group of line finders; and a plurality of link circuits is provided for each group of lines and line finders. The line finders and link circuits are divided into two subgroups and each subgroup normally serves calls in the corresponding subgroup of lines. The arrangement is such that, except when all link circuits are busy, a particular link circuit will be in readiness to serve a call and will be connected by its district finder to an idle line finder.

When a call is initiated by a subscriber in a particular group, the trip circuit individual to the group and the start circuit common to a plurality of trip circuits are taken for use by that line and means are provided for preventing the extension of a call in the other subgroup of the group or in any other group until the line finder has been started in search of this calling line. Means are also provided for preventing the extension of a second call in this group until after simultaneous calls in other groups have been taken care of. The operation of the start circuit causes the line finder associated with the link circuit allotted for use to hunt for the calling line and also causes the link circuit to hunt for an idle sender. As soon as a

particular link is taken for use with a call the next link is allotted to serve the next initiated call in the particular subgroups which it serves. As soon as a brush set on the line finder has been tripped the start circuit is freed to permit the extension of calls in other groups. As soon as the line has been found the trip circuit of the group is freed by the line finder to extend another call in the same group provided no call is awaiting extension in another group. As soon as selections are completed the sender and link circuit are released by the district selector circuit and the link circuit immediately hunts for another idle district selector.

Substation 100 is one at which a coin box is located for the purpose of requiring prepayment for calls. Substations of this type are served by register senders which are arranged to prevent the completion of a connection unless the required coin is deposited in said coin box.

Extension of a local connection

When the subscriber at substation 100 removes his receiver from the switchhook a circuit is closed for line relay 101 extending from battery through that relay, inner contact of relay 102 over the line loop to ground at the outer contact of relay 102. Relay 101 operates and closes a circuit from battery, through the left winding of relay 103, right back contact of relay 104 to ground at the outer contact of relay 101, and, at its inner front contact, connects battery through resistance 111 and the left winding of relay 109 in parallel to conductor 114 to mark the line as calling.

The operation of relay 103 opens at its right back contact the operating circuit of relay 104 which serves the second subgroup of the group to which line 100 belongs, thus preventing the extension of a connection from that subgroup while the trip circuit is being used with line 100. At its middle left contact relay 103 establishes a circuit for the trip relay 108 extending from battery, left back contact of relay 201, conductor 130, right winding of relay 108, inner left back contact of relay 107, left back contact of relay 109 to ground at the middle left front contact of relay 103. Relay 108 operates and locks from battery, through the right winding of relay 201, conductor 129, back contacts of relays similar to relay 108 individual to other subgroups of lines appearing before the same line finder, inner left front contact and left winding of relay 108, right back contact of relay 109 to ground at the middle left front contact of relay 103. Relay 108 at its outer right front contact establishes a circuit for operating the trip magnet 303 of the line finder of Fig. 3. Relay 201 operates in the locking circuit of relay 108 and, in combination therewith, closes a cir-

cuit from ground at its outer right contacts, over conductor 128, the inner right contact of relay 108 to battery through the winding of relay 110. Relay 110 operates and locks over its inner right contact, the left back contact of relay 109 to ground at the middle left contact of relay 103 and at its outer contact establishes a circuit for starting an 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 1300 in position 2. The operation of relay 110 will therefore close a circuit from ground at its outer right contact, the outer left front contact of relay 108, the inner left front contact of relay 103, conductor 131, the left back contacts of relay 202, the left back contacts of relay 203, conductor 206, the upper left and lower right contacts of cam 403, brush 402 and terminal 401, conductor 378, the lower right and upper left contacts of cam 1301 to battery through the winding of relay 302.

Relay 302, in operating, closes a holding circuit for itself over its inner right front contact, the lower and upper left contacts of cam 1302, the back contact of relay 301 to ground over commutator segment 304 and brush 305 and, at its inner left front contact, establishes a circuit for the up-drive magnet 300 of the line finder extending over the upper contact of cam 1303, outer right front contact of relay 302 to ground at the upper left contact of cam 1304. The line finder moves upwardly under the control of magnet 300 and since trip magnet 303 is operated, the proper set of brushes is tripped. Relay 302 also establishes a circuit from ground at the upper left contact of cam 1304, over the outer right front contact of relay 302, lower left contact of cam 1305, conductor 379, terminal 407, brush 406, upper right and lower left contacts of cam 405, conductor 207, right winding of relay 203 to battery at the inner left normal contacts of relay 208. Relay 203 operates and opens at its left back contacts the initial operating circuit of relay 302. As soon as commutator brush 306 engages segment 307 a circuit is established from ground on brush 306, left contacts of cam 1306, conductor 404, contact 230 of key 204, inner right contact of relay 201 to conductor 129 and the right contact of relay 201. This circuit shunts the winding of relay 108 and causes that relay to release, in turn releasing the trip magnet 303. When brush 306 leaves segment 307 the circuit of relay 201 is opened and that relay also releases. When the line finder brush 308 makes contact with terminal 309, which is connected to conductor 114 and therefore to battery, a circuit is completed from this battery, conductor 316, outer right back contact of relay 310, conductor 311, upper con-

tact of cam 1401, conductor 312, winding of relay 301, conductor 313, upper left and lower right contacts of cam 1307 to ground. Relay 301 operates in this circuit and closes a shunt around its winding from ground on brush 305, segment 304, front contact of relay 301, conductor 314, left contact of cam 1402, conductor 315, resistance 1308, conductor 316 to brush 308. This reduces the resistance in series with the winding of marginal relay 109 sufficiently to cause that relay to operate and open the locking circuit of relay 110. The operation of relay 301 also opens the locking circuit previously traced for relay 302 and relay 302 releases as soon as the line finder brushes are centered on the calling line terminals when commutator brush 317 will be in engagement with an insulating portion of centering segment 318. The release of relay 302 opens the circuit of up-drive magnet 300 and establishes the circuit of cut-off relay 102 from battery, through the winding of relay 102, conductor 112, terminal 319, brush 320, resistance 1309, outer left back contact of relay 310, middle right back contact of relay 302, upper contacts of cam 1310 to ground at the lower contact of cam 1311. The operation of cut-off relay 102 opens the circuit of line relay 101, removing battery from conductor 114, releasing relays 109 and 301.

At the time relay 302 operated and closed a circuit from ground over conductor 379, terminal 407, brush 406, for operating relay 203, a circuit was also established from brush 406, lower right contact of cam 408, winding of relay 409 to battery through resistance 411. 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 sequence switch 400 to position 2. When sequence switch 400 leaves position 1 relay 409 releases. In position 2 a circuit is closed from battery, through the winding of relay 413, left contacts of cam 414, right back contact of relay 415 to ground at the upper right contact of cam 416. Relay 413 operates closing a circuit from battery, through the left winding of relay 417, right 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 up-drive magnet 418 of the sender finder 420, left contact of cam 479, outer right contact of relay 417 to ground at the left back contact of relay 409. The sender finder moves 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, left contacts of cam 421, middle winding of relay 415 to ground at the left front contact of relay 413. The current in this circuit, how-

ever, 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 closed. The test circuit extends from brush 422, over the lower contacts of cam 419, right back contact of relay 409, left winding of relay 415, upper right and lower left contacts of cam 421, middle winding of relay 415 to ground through the left front contact of relay 413. An idle sender is characterized by battery connected over conductor 502 to terminal 423. When, therefore, brush 422 engages terminal 423 corresponding to the sender of Figs. 5 to 10, inclusive, which is assumed to be idle, the test circuit is completed over conductor 502, back contacts of relay 510 and 512 to battery through resistance 501. Relay 415 operates quickly closing a locking circuit for itself from battery through its right winding, left contacts of cam 421 to ground at its left front contact. It also opens the circuit of relay 417 which releases and in turn releases magnet 418 to 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, upper left contact of cam 476, contacts 427 of jack 428, left back contact of relay 413, right front contact of relay 415 to ground at the upper right contact of cam 416, advancing sequence switch 400 to position 3.

When sequence switch 400 advanced to position 2 to hunt for an idle sender, a circuit was closed for relay 321 extending from battery, right winding of relay 321, lower left contact of cam 1312, lower right contact of cam 1313, conductor 375, terminal 477, brush 478 to ground at the right contact of cam 429. When relay 302 releases as above described with relay 321 operated, a circuit is closed for advancing sequence switch 1300 into position 3 extending from battery, winding of magnet 1300, upper left contact of cam 1314, left front contact of relay 321, outer right back contact of relay 302 to ground at the upper left contact of cam 1304. As sequence switch 1300 advances from position 2 to 3, relay 321 releases. From position 3 to 17¼ the calling line cut-off relay 102 is maintained operated over terminal 319, brush 320, resistance 1309, the left back contact of relay 310 to ground at the upper right contact of cam 1311.

When sequence switch 400 reaches position 3, a circuit is closed from ground, through the right and middle windings of relay 503, inner left back contact of relay 504, outer right back contact of relay 505, conductor 506, terminal 430, brush 431, upper contact of cam 434, brush 432 and terminal 433, conductor 322, lower right and upper left contacts of cam 1315 to battery through the winding of relay

323 and in parallel therewith over the upper right contact of cam 1315, conductor 1437, lower contacts of cam 1403, conductor 339 to battery through the left winding of relay 324.

5 Relay 324 is marginal and does not operate and relay 323, although operating, is not effective at this time. Relay 503 also operates and closes an obvious circuit for relay 507 which in turn closes a circuit from battery, 10 through resistance 508, winding of relay 509, middle left front contact of relay 507 to ground. Relay 509 operates and locks over its inner right front contact. Relay 507 closes a circuit for relay 510 from battery, 15 winding of relay 510, conductor 534 to ground at the inner left front contact of relay 507. It also closes a circuit from battery, through the winding and right normal contact of relay 601, normal contact of brush 602 of timing 20 switch 600 and thence to ground over conductor 534 to the inner right front contact of relay 507. The operation of relay 510 closes an obvious circuit for relay 511 which in turn closes a circuit through the left winding of 25 relay 512. The operation of relay 601 closes a circuit from battery, through the winding of relay 603, normal terminal and brush 604 of switch 600, inner left front contact of relay 601 to ground. Relay 603 operates and closes 30 a circuit through the winding of stepping magnet 605 and its back contact, front contact of relay 603, brush 604 and its normal terminal to ground at the inner left contact of relay 601. Magnet 605 operates and steps 35 switch 600 to its first terminal. The further operation of the timing switch will be described later.

The operation of relay 512 opens the circuit previously traced through battery and resistance 501 and the windings of relay 415 and 40 relay 415 releases. With relay 415 released, a circuit is closed from battery, through the winding of sequence switch magnet 400, lower left contact of cam 476, right back contact of 45 relay 415 to ground at the upper right contact of cam 416. Sequence switch 400 advances to position 5 over this circuit and remains in this position throughout the further operation of the sender.

50 As soon as sequence switch 400 arrived in position 2 $\frac{3}{4}$ it prepared a pulsing circuit for receiving dial pulses. This circuit may be traced from battery, through the left winding of relay 606, conductor 637, left back contact of relay 1200, left back contact of relay 55 1201, conductor 1202, terminal 445, brush 444, lower left and upper right contacts of cam 403, brush 443, terminal 442, conductor 382, left contact of cam 1316, winding of relay 1317, outer right back contact of relay 324, brush 325, terminal 326, line conductor 116, substation of calling line 100, line conductor 117, terminal 327, brush 328, inner 60 right back contact of relay 324, left contact of cam 1318, conductor 375, terminal 477, brush

478, lower contact of cam 429, brush 441, terminal 440, conductor 1203, right back contact of relay 1204, right back contact of relay 1200, to ground. Relay 606 operates and closes 70 a circuit for relay 610 extending from battery through the winding of relay 610, front contact of relay 606 to ground at the inner left back contact of relay 515. Relay 610 operates and closes a circuit from battery, 75 through the winding of relay 609, right front contact of relay 610, conductor 638, lower left contact of cam 516 to ground. As soon as relay 609 operates the dialing tone circuit is completed from source of tone 607, right 80 winding of relay 606, normal terminal and brush 804 of register steering switch 800, outermost left contact of relay 609, conductor 618, lower contact of cam 514, conductor 534 to ground at the inner left front contact of relay 507. Due to the closure of this circuit a 85 tone is induced in the left winding of relay 606 and over the dialing circuit to the receiver of the calling subscriber's substation to indicate that dialing may be started.

The subscriber now dials the number of 90 the wanted subscriber and the registers 810, 820, 1000, 1010, 1020, 1030 and 1040 are positioned as described in the patent to O. H. Kopp, No. 1,589,402, granted June 22, 1926. As soon as registers 810 and 820 are set trans- 95 lator 830 is positioned to control various selection after which class sequence switch 950 is positioned. As soon as the translator is positioned sequence switch 500 is advanced to 100 position 2.

With sequence switch 500 in position 2 the fundamental circuit is completed from battery, through the right winding of relay 321, lower left contact of cam 1312, lower 105 left contact of cam 1313, conductor 378, terminal 401, brush 402, lower right and upper left contacts of cam 435, brush 436, terminal 437, right back contact of relay 504, right contact of cam 701, winding of stepping relay 702, back contact of relay 703, left wind- 110 ing of relay 704, left contact of cam 705, inner left contact of relay 620, middle left contact of relay 621, resistance 623 to ground; relays 620 and 621 having energized upon the setting of the translator switch 830 in the 115 manner set forth in the aforementioned patent to O. H. Kopp. Relays 321 and 702 operate in this circuit, but relay 704 being polarized does not operate. Relay 321 locks over its inner right front contact, the upper left 120 contact of cam 1312 to the fundamental circuit as previously traced. Relay 321 also closes a circuit from battery, through the winding of sequence switch magnet 1300, up- 125 per left contact of cam 1314, left front contact of relay 321, outer right back contact of relay 302 to ground at the upper left contact of cam 1304. Magnet 1300 energizes in this circuit and advances the sequence switch 130

into position 4 in which position the energizing circuit for relay 321 is opened, but the locking circuit is maintained closed.

In position 4 with relay 321 operated a circuit is closed from battery, through the winding of up-drive magnet 1319, lower contacts of cam 1310, left front contact of relay 321, outer right back contact of relay 302 to ground at the upper left contact of cam 1304. The up-drive magnet energizes in this circuit and causes the district selector switch shaft to move upwardly in a brush selecting movement. Each time that brush 1320 makes contact with a conducting segment of commutator strip 1321 a circuit is established from ground at the lower contact of cam 1311, brush 1320, segment 1321, upper left contact of cam 1313, thence to the fundamental circuit holding relay 321 operated and shunting the sender stepping relay.

When the fundamental circuit above traced was closed and stepping relay 702 operated, it closed a circuit from battery, inner left contact of relay 621, left contact of cam 519, winding of the No. 3 counting relay, (assuming that the translator has been set in position to select the fourth brush on the district selector) back contact of the No. 3' counting relay, conductor 706, translator brush 855 and its corresponding terminal, right contacts of cam 707, inner left back contact of relay 708, left contact of cam 520, contact of relay 702, lower left contact of cam 518 to ground. The No. 3 counting relay operates in this circuit and locks through the winding of the No. 3' counting relay, front contact of the No. 3 counting relay, upper right contact of cam 709 to ground. The No. 3' counting relay does not operate at this time since its winding is shunted by the energizing circuit of the No. 3 counting relay. When, in its upward movement, brush 1320 of the district selector encounters the first conducting segment of commutator strip 1321, stepping relay 702 is shunted and deenergized, opening the above traced circuit for the No. 3 counting relay permitting the No. 3' counting relay to operate in the locking circuit of the No. 3 counting relay.

The energization of the No. 3' counting relay connects conductor 706 through the back contact of the No. 2' counting relay to the winding of the No. 2 counting relay and thence to battery. When brush 1320 encounters an insulating segment the shunt is removed from relay 702 and that relay again energizes closing the circuit from ground to conductor 706 causing the energization of the No. 2 counting relay. As the district selector switch shaft continues upwardly and brush 1320 engages the insulating and conducting portions of the commutator strip 1321, stepping relay 702 is alternately deenergized and energized and the counting relays are successively operated. When brush

1320 reaches the fourth conducting segment and stepping relay 702 deenergizes for the fourth time the No. 0' counting relay operates in parallel with relays 703 and in series with the No. 0 counting relay. The operation of relay 703 opens the fundamental circuit and permits the release of relay 321 as soon as brush 1320 leaves the conducting segment. The operation of the No. 0' counting relay closes a circuit from battery through the winding of sequence switch magnet 700, right contact of cam 710, left back contact of relay 708, front contact of the No. 0' counting relay to ground at the inner back contact of relay 711, sequence switch 700 is energized in this circuit and advances the sender sequence switch to position 3. As soon as sequence switch 700 leaves position 1 $\frac{1}{4}$ the locking circuits of all operated counting relays are opened, releasing such relays. The release of relay 321 as previously described opens the circuit of the up-drive magnet 1319 and closes a circuit from battery, through the winding of sequence switch magnet 1300, lower contacts of cam 1322, outer left back contact of relay 321, back contact of relay 302 to ground, in which circuit the sequence switch is advanced to position 5.

With sequence switch 1300 in position 5 and sequence switch 700 in position 3 the fundamental circuit is again closed from battery, through the right winding of relay 321, lower left contact of cam 1312, lower left contact of cam 1313, conductor 378, thence as traced previously, outer right back contact of relay 504, right contact of cam 701, winding of relay 702, contact of relay 703, left winding of relay 704, left contact of cam 705, innermost right contact of relay 620, middle left contact of relay 621, resistance 623 to ground. Relays 321 and 702 operate in this circuit as before. Relay 321 locks as previously described and closes the previously traced circuit for sequence switch 1300 in which circuit the sequence switch advances to position 6. The operation of stepping relay 702 closes a circuit from battery, right contact of cam 519, through the winding of the No. 1 counting relay (assuming that the translator is set in position to cause the selection of the second group of outgoing trunks served by the fourth set of brushes) back contact of the No. 1' counting relay, conductor 712, translator brush 854, lower left and upper right contacts of cam 707, inner right back contact of relay 708, left contact of cam 520, contact of relay 702, lower left contact of cam 518, to ground. In positions 5 to 7, inclusive, of sequence switch 1300, trip magnet 1323 is energized in a circuit extending from battery through its winding to ground at the lower right contact of cam 1324. When the sequence switch arrives in position 6 up-drive magnet 1319 is again energized and the district selector switch shaft

is moved upwardly in a group selecting movement. Due to the energization of trip magnet 1323 and the positioning of the district selector in accordance with the brush selecting operation just described the fourth brush set is tripped and moved over its corresponding terminals.

As in the case of brush selection a shunt circuit is prepared extending from ground over the lower contact of cam 1311, brush 1325, commutator segment 1326, upper right contact of cam 1312 to the fundamental circuit as previously traced. As the district selector moves upwardly the stepping relay 702 will be intermittently shunted and the counting relays operated beginning with the No. 1 counting relay. When the No. 0 counting relay operates at the second release of relay 702, relay 703 is operated releasing relay 321 and bringing the district selector to rest with its brushes engaging the first terminal of the second group to which the fourth brush set has access. The release of relay 321 also closes a circuit from battery through the winding of sequence switch magnet 1300, lower contacts of cam 1322, outer left back contact of relay 321 to ground over the back contact of relay 302 advancing the sequence switch to position 7.

In position 7 of sequence switch 1300 relay 321 is operated over its left winding, lower left contact of cam 1327, left contact of cam 1302, back contact of relay 301, line finder commutator segment 304 and brush 305 to ground. The operation of relay 321 closes a circuit from battery, through the winding of sequence switch magnet 1300, upper left contact of cam 1314, left front contact of relay 321 to ground over the back contact of relay 302, thus advancing sequence switch 1300 into position 8. From position 7½ to 9 relay 321 locks over its right winding and inner right front contact, upper right contact of cam 1307, right contact of cam 1328, to sleeve brush 1329 and ground on sleeve terminal 1330, provided that this trunk is busy. The energizing circuit of relay 321 is opened in position 8. If the first trunk of the group is busy and relay 321 is held energized in position 8 a circuit is completed for up-drive magnet 1319 from battery, through the winding of magnet 1319, lower contacts of cam 1310, left front contact of relay 321 to ground over the back contact of relay 302. The up-drive magnet is energized and causes the district selector shaft to move upwardly in search of an idle outgoing trunk. Relay 321 is held operated between terminals over a circuit extending from battery, left winding of relay 321, lower left and upper right contacts of cam 1327, commutator segment 1331, brush 1332, upper right and lower left contacts of cam 1310, left front contact of relay 321, back contact of relay 302 to ground. As soon as an idle

trunk is reached, characterized as such by the absence of ground on its sleeve terminal, the locking circuit of relay 321 is opened and the relay releases in turn releasing the up-drive magnet and bringing the district selector to rest on the first idle outgoing trunk of the group. The release of relay 321 closes a circuit from battery, winding of sequence switch magnet 1300, lower contacts of cam 1322, left back contact of relay 321, back contact of relay 302 to ground, advancing the sequence switch to position 9.

As soon as relay 321 releases, ground is connected to sleeve terminal 1330 over brush 1329, the right contact of cam 1328, the upper right contact of cam 1307, the right back contact of relay 321 to ground at the left contact of cam 1311 for holding the trunk busy while sequence switch 1300 is passing from position 8 to 9. In position 9 ground is connected to brush 1329 over the right contact of cam 1328 and the lower right contact of cam 1307. With sequence switch 1300 in position 9 relay 321 operates over a circuit extending from battery, left winding of relay 321, left contacts of cam 1333, right contact of relay 323 to ground at the lower contact of cam 1324 and closes a circuit from battery, winding of sequence switch magnet 1300, upper left contact of cam 1314, left front contact of relay 321, back contact of relay 302 to ground on upper left contact of cam 1304 for advancing sequence switch 1300 into the selection beyond position 10. In position 10 relay 321 remains energized over the circuit previously traced.

The fundamental switch controlling circuit may now be traced in part from brush 1334, upper right and lower left contacts of cam 1335, right back contact of relay 329, conductor 378, terminal 401, brush 402, lower right and upper left contacts of cam 435, brush 436, terminal 437, right back contact of relay 504, upper right contact of cam 523, left contact of cam 954, lower contact of cam 719, resistance 718, lower left contact of cam 717, winding of relay 716, left winding of relay 704, right contact of cam 525, brush 839 of translator 830, compensating resistance 859, outer left back contact of relay 524, outer left front contact of relay 507, terminal 439, brush 438, right contacts of cam 405, brush 406, terminal 407, conductor 379, right contacts of cam 1336, to brush 1337. Subsequent selections now take place as described in the above identified patent of O. H. Kopp with the exception of the manner by which is insured that a coin has been deposited at the calling subscriber's substation before permitting the completion of a connection.

The operation of relay 507 at the time the sender was selected closed a circuit for relay 601 which, in operating, operated relay 603. Relay 603 closed a circuit from battery, through the winding of stepping magnet

605, for advancing switch 600 to its first off-normal position as previously described. With the brushes of switch 600 engaging their first off-normal terminals a circuit is completed from battery, through the winding of relay 1205, No. 1 terminal of brush 602, conductor 534 to ground. Relay 1205 operates and locks over its right front contact, outer right back contact of relay 1207, outer left back contact of relay 526, inner left back contact of relay 539 to ground over conductor 534. Upon leaving normal, switch 600 releases relay 603.

The operation of relay 1205 closes a circuit from battery, through the winding of relay 603, brush 604, and its No. 1 terminal, left front contact of relay 1205 to ground over conductor 534. Relay 603 operates and causes the operation of magnet 605 to advance switch 600 to its No. 2 position whereupon relay 603 releases. The stepping magnet 605 is then energized over the contact of interrupter 628, No. 2 and 3 terminals of brush 629, outer right back contact of relay 603 to ground at the right normal contact of relay 1201. Switch 600 is advanced one step each time that interrupter 628 closes its contact and comes to rest in its No. 4 position. If dialing has not been started at this time, no circuit is closed for advancing this switch to its No. 5 position and the call is directed to the sender monitor operator's position in the manner described in the above identified patent to O. H. Kopp.

If dialing has commenced and steering switch 800 has been advanced to its No. 1 position when switch 600 steps to its No. 4 position a circuit is closed from battery through the winding of relay 603, brush 631 and its No. 4 terminal, off-normal terminals of brush 805 to ground. Relay 603 operates and causes the operation of stepping magnet 605, advancing switch 600 immediately to its No. 5 position. Switch 600 advances to its No. 7 position under the control of interrupter 628.

If switch 800 has not been advanced to its No. 8 or No. 9 position at this time, a circuit is closed from battery through lamp 632, resistance 633, No. 7 terminal and brush 629, outer right back contact of relay 603 to ground at the back contact of relay 1201, and switch 600 remains in this position. However, if switch 800 is in its No. 8, 9 or 10 position a circuit is closed from battery, through the winding of relay 603, brush 631 and its Nos. 5 to 7 terminals, terminals Nos. 8 to 10 of brush 805 to ground. The operation of relay 603 causes the stepping magnet 605 to step switch 600 to its No. 8 position. Switch 600 is now advanced from the No. 8 to the No. 12 position due to the operation of relay 603 over brush 631, left back contact of relay 634 to ground at the back contact of relay 1201. It then advances to its No. 15 position due to the operation of relay 603 through brush

631 to ground on terminals Nos. 12 to 14.

Testing coin box for deposited coin

When switch 600 reaches its No. 15 position a circuit is completed from battery through the winding of relay 1200, outer left back contact of relay 539, terminal No. 15 and brush 602 to ground over conductor 534. The operation of relay 1200 transfers the tip conductor from ground to the right winding of relay 1206, inner right back contact of relay 1207, right winding of relay 1208, resistances 1209 and 1210 to ground, and the ring conductor from the winding of relay 606 to the left winding of relay 1206 inner left back contact of relay 1207, left winding of relay 1208, resistance 1211, outer right front contact of relay 1200 to battery. The operation of relay 1200 also closes a substitute circuit for relay 606 over the left alternate contact of relay 1200 through resistance 1212 to ground. Relay 1206 operates in the above traced circuit and remains operated during coin test unless the calling subscriber replaces his receiver on the switchhook.

If the subscriber abandons the call at this time relay 1206 releases and connects battery through the 52.5 ohm resistance 905 over its left back contact, and outer left front contact of relay 1200 to the winding of relay 606, releasing that relay to permit the restoration of the sender. Relay 1208 tests for the presence of ground at the subscriber's substation. It will be operated by ground through a resistance of 0 to 1000 ohms but will not be operated by a 10,000 ohm leak.

Assuming that a coin has been deposited in coin box 140 relay 1208 will be operated. Relay 1208 locks from battery through the outer right contact of relay 1200, resistance 1211, left winding and contact of relay 1208 to ground on conductor 534 as previously traced. The operation of relay 1208 closes a circuit from battery over the right contact of relay 1208, winding of relay 1207, left back contact of relay 526, inner left back contact of relay 539 to ground over conductor 534. Relay 1207 operates and transfers the tip and ring conductors from the windings of relay 1208 to the middle and right windings of relay 1213. Relay 1213 is so adjusted as to be operated by direct ground at the subscriber's substation but is not operated by ground through the windings of the coin magnet, which has a resistance of about 1000 ohms. The operation of relay 1207 also opens the holding circuit of relay 1205 but relay 1205 is slow to release so that relay 1213 has sufficient time to operate and lock before relay 1205 closes its back contact. If, due to a trouble condition or an attempt to obtain a free call, a direct ground is present at the subscriber's substation, relay 1213 operates and is held operated in a circuit from battery, right contact of relay 1208, left

winding of relay 1213, outer left back contact of relay 526, inner left back contact of relay 539 to ground on the conductor 534. The operation of relay 1213 connects ground from conductor 534, over the inner left back contact of relay 539, outer left back contact of relay 526, front contact of relay 1213, right front contact of relay 1205, through the winding of relay 1205 to battery, holding that relay operated.

During the above operations switch 600 is advanced from position 15 to position 17 due to the closure of a circuit from battery, through the winding of stepping magnet 605, contact of interrupter 628, No. 15 and 16 terminals and brush 629, right back contact of relay 603 to ground at the right normal contact of relay 1201. If relay 1205 is not released when switch 600 reaches its No. 17 position, lamp 650 is lighted in a circuit from battery through lamp 650, No. 17 terminal and brush 629, right back contact of relay 603 to ground at the right normal contact of relay 1201. This lamp is located at an operator's position and the operator, observing the lamp, inserts a plug in jack 1214. Battery on the sleeve of the operator's cord circuit causes the operation of relay 1201 which in turn causes the operation of relay 1204. The operation of relay 1204 extends the tip and ring conductors to the operator's cord circuit so that she may converse with the calling subscriber. The operation of relay 1204 also opens the circuit of relay 1208 and that relay releases. When the operator removes her plug from jack 1214, relays 1201 and 1204 release and the conductors are again extended to relay 1208 so that the coin test may be repeated.

If, as assumed, the coin is properly deposited relay 1213 does not operate and, when relay 1205 closes its back contact, a circuit is completed from battery through the inner left contact of relay 621, right winding of relay 539, back contact of relay 1205, to ground over conductor 534. Relay 539 operates and opens the circuit of relay 1200, in turn releasing relay 1208. The operation of relay 539 also closes a circuit from battery through the winding of relay 603, brush 631 and its No. 17 terminal, left front contact of relay 539 to ground over conductor 534. Relay 603 causes the advance of switch 600 to its No. 18 position. As soon as switch 600 leaves its No. 17 terminal relay 603 releases.

When the sender sequence switch arrives in position 13 on its second revolution, preparatory to making final units selection, a circuit is closed from battery through the winding of relay 711, upper contacts of cam 527, outer left back contact of relay 515, lower right contact of cam 727, upper right and lower left contacts of cam 533, left front

contact of relay 1205, to ground over conductor 534, provided relay 1205 is still operated.

If relay 1205 is still operated and relay 711 operates, the circuit for advancing sequence switch 700 for final units selection is opened and the completion of a call is prevented. If, as above described, the coin has been properly deposited and relay 1205 released, relay 711 is either not operated at all or released after a short interval and the call is completed as above described in the above identified application of O. H. Kopp. Switch 600 is advanced from its No. 18 to 21 position in a circuit from battery through the winding of stepping magnet 605, contact of interrupter 628, terminals Nos. 18 to 20 and brush 629, right back contact of relay 603 to ground at the right normal contact of relay 1201. If selections have not been completed by the time switch 600 reaches its No. 20 position, a circuit is completed from battery, through the winding of relay 603, brush 631 and its No. 20 terminal, right contact of cam 957 to ground, and relay 603 operates advancing switch 600 immediately to its No. 21 position. As switch 600 enters its No. 21 position, lamp 632 is lighted in a circuit from battery, through the lamp, right back contact of relay 634, contact of interrupter 635, No. 21 terminal of brush 629, right back contact of relay 603 to ground at the right normal contact of relay 1201. Lamp 632 flashes in this circuit indicating to the sender monitor that the selections have not been properly completed.

If selections have been completed and the sender disconnected, the circuit of relay 601 is opened and that relay releases closing a circuit from battery, through the winding of relay 603, brush 604 and its off-normal terminals to ground at the back contact of relay 601 restoring switch 600 to normal. This circuit is completed whenever relay 601 is released. The release of the sender is as described in the above identified patent of O. H. Kopp.

Talking selection

Assuming that this is a call for which a charge is to be made, district selector sequence switch 1300 should be advanced to either position 13 or 14. When selections beyond are completed the sender sequence switch 700 advances to position 18 and relay 504 becomes operated in the manner described in the aforementioned patent to O. H. Kopp. The operation of relay 504, above mentioned, now opens the shunt around the left winding of relay 503 including that winding in the circuit of relays 323 and 324. Relay 323 thereupon releases in turn releasing relay 321. Upon the release of relay 321 the district sequence switch 1300 is advanced into position 11 over a circuit extending from

battery, winding of magnet 1300, lower contacts of cam 1322, left back contact of relay 321, back contact of relay 302 to ground. As the sequence switch enters position 11 ground is connected to conductor 322 at the lower left and upper right contacts of cam 1310 to contact of cam 1304 which is extended 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, outer right back contact of relay 505 to the windings of relay 503. Since these windings are also connected to ground, relay 503 now releases in turn releasing relay 507. The release of relay 507 does not release relay 509 since that relay is locked to its own front contact. A circuit is therefore closed from ground, over the middle left back contact of relay 507, middle right front contact of relay 509 to the winding of relay 505 which locks. After leaving position 10, relays 323 and 324 are both disconnected from conductor 322. Sequence switch 1300 is then advanced into position 12 over a circuit extending from battery, through magnet 1300, the upper left contact of cam 1314, lower left ground at the lower contact of cam 1311. In passing into position 12 the subscriber's line becomes disconnected from the sender at contacts of cams 1316 and 1318.

With sequence switch 1300 in position 12 relay 321 is energized in a circuit extending from battery, right winding of relay 321, the lower left contact of cam 1312, the lower left contact of cam 1313, conductor 378, terminal 401, brush 402, the lower right and upper left contacts of cam 435, brush 436, terminal 437, outer right front contact of relay 504, lower left contact of cam 701, winding of relay 702, back contact of relay 703, resistance 740, right contacts of cam 705, right back contact of relay 507 to ground through resistance 623. Relays 702 and 321 operate, relay 321 closing a circuit extending from battery, through sequence switch magnet 1300, upper left contact of cam 1314, left front contact of relay 321 to ground at the lower right contact of cam 1304. Relay 321 upon energizing locks to the fundamental circuit over its inner right front contact and the upper left contact of cam 1312. As sequence switch 1300 rotates out of position 12 toward position 16, ground is intermittently applied to the fundamental circuit in shunt of sender stepping relay 702 at the right contacts of cam 1307. When the sender is satisfied as to its talking selection setting, the fundamental circuit is opened at the sender through the operation of relay 703 and relay 321 deenergizes arresting sequence switch 1300 in its next stepping position. The sequence switch may be arrested in one of three positions, positions 13 or 14 which are charge

positions and position 15 for connections to an operator's position. If sequence switch 1300 steps in position 13 it immediately advances into position 14 over a circuit closed at the upper right contact of cam 1324.

As soon as switch 1300 advanced out of position 10, relay 1317 operated over the calling line loop from battery through the right upper and left lower contacts of cam 1404, lower left winding of repeating coil 1338, inner lower back contact of relay 1339, upper right contact of cam 1316, through the winding of relay 1317, thence as previously traced over the calling line loop to the lower contact of cam 1318, upper back contact of relay 1339, upper left winding of repeating coil 1338, left upper contact of cam 1405 to ground. Relay 1317 operates and holds relay 323 operated after sequence switch 1300 leaves position 11 over a circuit through the winding of relay 323, front contact of relay 1317 to ground at the lower contacts of cam 1307.

At the sender, after talking selection is completed, relay 515 operates connecting battery through resistance 501 to conductor 506 in parallel with the winding of relay 505 whereupon relay 415 in the link circuit receives sufficient current to operate. Following the operation of relay 415, the link sequence switch 400 advances to position 6, dismisses the sender and the link circuit, then functions in the manner fully set forth in the patent to A. E. Hague No. 1,696,271, granted December 25, 1928, to allot another line finder district selector link for use on the next call and to set the link circuit sequence switch 400 into position 10 which is the allotted position for the link circuit.

Response to the called subscriber

When the called subscriber responds, a circuit is established for relay 1340 which may be traced in part from brush 1334, upper contacts of cam 1335, upper right winding of repeating coil 1338, winding of polarized relay 1340, lower right winding of coil 1338, lower contacts of cam 1336, to brush 1337. Relay 1340 operates and closes a circuit which may be traced from battery, winding of relay 302, lower contact of interrupter 1341, upper left and lower right contacts 1327, conductor 1406, left contacts of cam 1407, conductor 1408, front contact of relay 1340 to ground at the upper right contact of cam 1304. Relay 302 operates and locks over its inner right front contact, the lower contact of cam 1302, lower right contact of cam 1327, thence as traced to ground at the upper right contact of cam 1304 and, as soon as interrupter 1341 closes its upper contact, establishes a circuit for relay 1410 extending from ground as traced to conductor 1406, thence over the lower right and upper left contacts of cam 1327, 130

upper contact of interrupter 1341, outer right front contact of relay 302, lower right contact of cam 1303, conductor 1409, winding of relay 1410, right contacts of cam 1411, conductor 1412, resistance 330 to battery. Relay 1410 operates and locks over a circuit extending from battery, conductor 1412, right contacts of cam 1411, winding of relay 1410, upper right contact of cam 1413, upper left contact of cam 1414, left outer front contact of relay 1410, lower left contact of cam 1407, conductor 1408, front contact of relay 1340 to ground at the upper right contact of cam 1304 and establishes a circuit for advancing sequence switch 1400 to position 2. This circuit may be traced from battery, winding of magnet 1400, lower right contact of cam 1415, conductor 1419, left back contact of relay 324, conductor 1439, left contact of cam 1440, to ground at the inner left contacts of relay 1410. When sequence switch 1400 leaves position 1, relay 1410 releases and the locking circuit of relay 302 is opened at the left contacts of cam 1407. With sequence switch 1400 in position 2, a circuit is established from battery, winding of relay 329, lower right contact of cam 1413, lower left contact of cam 1414, conductor 1422, to ground over the right contacts of cam 1343. Relay 329 locks over its inner left contact to ground at the lower right contact of cam 1304, preparatory to operating the meter of the calling line if it is so equipped.

As soon thereafter as office timing circuit 1416 connects to conductor 1417, relay 301 operates over a circuit extending from ground, conductor 1417, lower left and right upper contacts of cam 1418, conductor 1419, left back contact of relay 324, conductor 1439, right lower contact of cam 1440, conductor 313, winding of relay 301, conductor 312, lower right contact of cam 1401, conductor 1420 to battery through resistance 1342. Relay 301 upon operating locks through battery over conductor 1420, the lower right contact of cam 1401, conductor 312, winding of relay 301, conductor 313, right lower contact of cam 1440, conductor 1439, left back contact of relay 324, conductor 1419, upper contacts of cam 1418, winding of relay 1421, left lower contact of cam 1402, conductor 314, front contact of relay 301 to ground over commutator segment 304 and brush 305. Relay 1421 being shunted by ground on conductor 314, does not operate in this locking circuit. At the end of thirty seconds ground is removed from conductor 1417 at the office timing circuit 1416 and relay 1421 operates closing a circuit from ground at its contact over the lower left contact of cam 1415 to battery through the winding of magnet 1400 thus advancing sequence switch 1400 to position 3.

Upon leaving position 2 the locking circuit of relays 301 and 1421 is opened at the upper contacts of cam 1418 and these relays release. When the sequence switch 1400 reaches position 3, relay 301 again operates locking as before through the winding of relay 1421 as soon as ground is connected to conductor 1417 by the office timing circuit. As soon as ground is removed again by the office timing circuit, relay 1421 operates in the locking circuit of relay 301 to advance sequence switch 1400 to position 4. In this manner sequence switch 1400 is advanced at thirty second intervals through the operation of office timing circuit 1416 and relays 1421 and 301 into position 12, thus measuring off a complete interval of five minutes for conversation.

As sequence switch 1400 enters position 11, a shunt is established from ground over the upper contacts of cam 1405 through resistance 1438, the upper left contact of cam 1404 to battery on the right upper contact of cam 1404, around resistance 1349 and condenser 1350 connected between the left windings of repeating coil 1338, thereby reducing the strength of the talking current flowing through the receiver of the calling substation. When sequence switch 1400 advances into position 12 this shunt is maintained from ground over the lower right contact of cam 1407, the left back contact of relay 1410, the right contacts of cam 1405, thence as traced through resistance 1438 to battery.

When sequence switch 1400 reaches position 12, a circuit is established from battery, winding of relay 331, right normal contacts of relay 310, conductor 332, upper left contact of cam 1413, lower left contact of cam 1414, conductor 1422, right contacts of cam 1343 to ground. Relay 331 operates connecting battery through resistance 333, inner left contact of relay 331, left back contact of relay 334, conductor 335 to multiplied terminals associated with brushes 1106 of all hunting switches 1100 of coin control circuits having access to the line finder district selector link circuit and closes a circuit for operating start relay 1110, which is common to said coin control circuits. This circuit extends from ground at the outer right back contact of relay 334, outer left contact of relay 331, conductor 336 to battery through the winding of relay 1110.

Relay 1110 upon operating closes the start circuit of the coin control circuit of Fig. 11, extending from ground at the front contact of relay 1110, upper normal contact 1111 of make busy jack 1112, back contact of relay 1113, left back contact of relay 1114, winding of magnet 1107 to battery. Magnet 1107 operates and closes an obvious circuit for magnet 1108 which causes switch 1100 to rotate in search of the terminal to which battery has been connected over conductor 335. All idle control circuits such as shown in

Fig. 11 are started in search of the line finder district selector link shown in Figs. 3 and 13. Busy coin control circuits have the above traced circuit for their magnets 1107 opened at the contacts of relay corresponding to relay 1114 and hence are not moved out of their rest positions.

When switch 1100 encounters the terminal connected to battery, a circuit is completed from battery on conductor 335, the terminal served by brush 1106, contact 1115 of jack 1112, winding of relay 1113, windings of relay 1116 to ground. Relay 1116 operates in this circuit and closes a shunt around its high resistance winding over its front contact and the lower contacts of jack 1112, thus reducing the resistance of the circuit through the winding of relay 1113 sufficiently to permit the operation of relay 1113. The operation of relay 1113 opens the circuit of magnet 1107, in turn releasing magnet 1108 and bringing switch 1100 to rest on the terminals of the line finder district selector link of Figs. 3 and 13. A circuit is also completed from battery through the winding of relay 1114, front contact of relay 1113, contact 1111 of jack 1112 to ground at the front contact of relay 1110, relay 1114 locking over its inner left front contact, brush 1105, and the terminal upon which it is resting, conductor 337, winding of relay 334, to ground at the outer right front contact of relay 331. Relay 1114 also opens at its left back contact another point in the circuit of magnet 1107.

Relay 334 upon operating opens the circuit of start relay 1110 to arrest the hunting movement of the started hunting switches and removes battery from conductor 335 and also establishes a circuit for relay 1410 extending from ground over the outer right front contact of relay 334, conductor 1423, lower contacts of cam 1424, winding of relay 1410, upper left and lower right contacts of cam 1401, conductor 1420 to battery through resistance 1342. Relay 1410 operates opening at its left back contact the ground side of the talking circuit extending over the calling line loop.

With the ground side of the talking current supply to the calling line opened, the talking current flowing over the calling line is gradually attenuated over a circuit extending from the calling substation, conductor 1117, terminal 327, brush 328, the inner right back contact of relay 324, the lower contact of cam 1318, the upper back contact of relay 1339, the upper left winding of repeating coil 1338, the upper right contact of cam 1405, resistance 1438, the left contacts of cam 1404, the lower left winding of repeating coil 1338, the inner lower back contact of relay 1339, the upper right contact of cam 1316, winding of relay 1317, outer right back contact of relay 324, brush 325, terminal 326 to line conductor 116. Due to the resistance

1438, the talking current over the calling line and through the left windings of repeating coil 1338 is attenuated gradually so that no surge of current is induced into the right windings of repeating coil 1338 and thence over the outgoing trunk circuit to the incoming selector which would cause the release of the incoming selector, and no objectionable click is produced in the calling subscriber's receiver which might otherwise occur if the talking current were cut off directly.

A holding circuit for relay 323 to prevent the release of the connection after the circuit of relay 1317 is opened through the later operation of relay 324 exists at this time, which may be traced from battery, winding of relay 323, conductor 1427, the upper left contact of cam 1441, conductor 1422 to ground at the right contacts of cam 1343. Relay 1410 closes a circuit from battery through the left winding of relay 324, conductor 339, left lower contact of cam 1425 to ground at the inner left front contacts of relay 1410. Relay 334 also opens the operating circuit of relays 1113 and 1116 and these relays release. Relay 324 upon operating transfers the tip and ring conductors of the calling line from their connection with the left windings of repeating coil 1338 to the coin control circuit.

The operation of relay 1114 also extends a circuit from ground through the left winding of relay 1125, inner right front contact of relay 1114, brush 1101 and the terminal upon which it is standing, conductor 338, lower left and upper right contacts of cam 1411, conductor 1412, to battery through resistance 330. Relay 1125 upon operating locks from battery through its right winding and inner right front contact to ground at the outer left front contact of relay 1114. Relay 1125, being operated, indicates to the coin control circuit that the call should be charged for through the collection of the deposited coin. The operation of relay 1114 also closes a circuit from battery through the left winding of relay 1117, winding of relay 1118, inner left back contact of relay 1117, outer left back contact of relay 1133, contact of interrupter 1120, to ground at the outer left front contact of relay 1114. Relay 1118 operates in this circuit upon the closure of the interrupter 1120, but relay 1117, being marginal, does not operate. Relay 1118 upon operating closes a locking circuit for itself from battery through the left winding of relay 1117, winding of relay 1118, right winding of relay 1117, inner right front contact of relay 1118 to ground at the outer left front contact of relay 1114. Relay 1117 does not operate in this circuit since its right winding is shunted by the energizing circuit of relay 1118. As soon as interrupter 1120 opens its contact, the shunt around the energizing winding of relay 1117 is removed and this relay now operates

through both of its windings in series with the winding of relay 1118 to ground on the left outer contacts of relay 1114. The operation of relay 1117 now closes a circuit from battery through the winding of relay 1121, left back contact of relay 1124, left outer front contact of relay 1117, left inner normally made contacts of relay 1119, left inner normal contacts of relay 1133 to ground at the outer left front contact of relay 1114. Relay 1121 operates, locks over its inner right contact, the outer right normal contacts of relay 1123, thence as traced to ground at the outer left front contact of relay 1114, closes a circuit for relay 1124, extending from battery through the winding of relay 1124, right middle contacts of relay 1121, left inner normally made contacts of relays 1119 and 1133 to ground on the left outer contact of relay 1114 and further connects through its right outer contact, the left winding of tone coil 1137 to a source of tone. Relay 1124 operates and locks over its right inner contact and thence as traced through contacts of relays 1121, 1119 and 1133 to ground at the outer left front contact of relay 1114.

The operation of relay 1121 establishes a short circuit of the conductors of the calling line through the middle and right windings of tone coil 1137 extending from conductor 117, terminal 327, brush 328, inner right front contact of relay 324, brush 1103 and the terminal upon which it is resting, left inner contact of relay 1121, middle winding of tone coil 1137, right winding of said tone coil, left outer contact of relay 1121, brush 1104 and the terminal upon which it is standing, outer right front contact of relay 324, brush 325, terminal 326 to conductor 116. Conductors 116 and 117 are thus connected over the circuit previously traced to a discharge path to ground through a resistance and condenser connected to both the right and middle windings of tone coil 1137.

The connection of the tip and ring of the line through both windings of the tone coil, together with the closure of the left winding of said coil to a source of tone, induces a tone over the subscriber's line as a warning signal to him that the conversation period for which he has made a prepayment is about to terminate, that the coin will be collected and that if he wishes to continue to talk for another period he should deposit an additional coin or coins. Since relay 1125 was operated, positive coin collect potential of 110 volts is simultaneously connected to the conductors of the calling line from a source of positive coin current, ballast lamp 1127, left outer front contact of relay 1125, winding of relay 1126, right contact of relay 1117, middle and right windings of tone coil 1137 in parallel, thence as previously traced to line conductors 116 and 117 and to ground at the coin box 140 if a coin is in the box. Relay 1126 operates in

this circuit if a coin is present in the coin box 140 as it should be, and closes an obvious circuit for relay 1122. Relay 1122 operates and locks in a circuit from battery through its winding and front contact to ground at the outer left front contact of relay 1114, and performs a function which will be hereinafter described.

When the interrupter 1120 again closes its contacts, it shunts the winding of relay 1118 from ground at the outer left front contact of relay 1114, contact of interrupter 1120, outer left back contact of relay 1133, inner left front contact of relay 1117, winding of relay 1118, right winding of relay 1117, inner front contact of relay 1118, to ground at the outer left front contact of relay 1114. Relay 1118 releases, but relay 1117 remains locked to ground over its inner left front contact. When interrupter 1120 again opens, the locking circuit of relay 1117 is opened and relay 1117 releases closing the energizing circuit of relay 1123 from battery, winding of relay 1123, inner right normally made contacts of relay 1123, left front contact of relay 1124, back contact of relay 1118, left back contact of relay 1128, outer left bank contact of relay 1117, left normal contacts of relays 1119 and 1133 to ground at the outer left front contact of relay 1114. Relay 1123 locks over its inner right alternate contacts to ground at the front contact of relay 1114, opening its operating circuit and, at its outer right transfer contacts, transfers the holding circuit of relay 1121 over the left back contact of relay 1118, the left back contact of relay 1128, the outer left back contact of relay 1117 to ground at the outer left front contact of relay 1114. At the next closure of interrupter 1120, relay 1118 again operates over the circuit previously traced, locks over the circuit previously traced through the windings of relay 1117, and opens the holding circuit of relay 1121 which releases. When the interrupter 1120 again opens its contacts, relay 1117 operates and establishes a circuit for relay 1128 extending from battery, winding of relay 1128, outer left front contact of relay 1123, outer left front contact of relay 1117 to ground at the outer left front contact of relay 1114. Relay 1128 upon operating locks directly to ground at the front contact of relay 1114, and, at its right contacts, connects the tip and ring conductors of the calling line to battery through the windings of relay 1134. Relay 1134 remains connected for the remainder of the open period of interrupter 1120 and if the coin has been collected and consequently ground has been removed at the coin box 140 said relay 1134 does not operate.

As soon as the interrupter 1120 closes its contacts, relay 1118 becomes shunted in the manner previously described and releases, closing a circuit from battery, left winding of relay 1119, middle left back contact of re-

lay 1133, outer right front contact of relay 1128, left front contact of relay 1124, left back contact of relay 1118, to ground at the outer left front contact of relay 1128. At its
 5 inner left front contact relay 1119 opens the holding circuit of relays 1128, 1123 and 1124 causing their release and locks over its inner left contacts and the left normal contacts of relay 1133 to ground at the outer left front
 10 contact of relay 1114. With relay 1119 operated, a circuit is established from battery, left winding of relay 310, conductor 340, terminal and brush 1102, outer left front contact of relay 1119, left back contact of relay 1135
 15 to ground at the outer left front contact of relay 1114. Relay 310 operates and locks over its right winding and right front contact, inner left front contact of relay 324 to ground at the upper right contact of cam 1311 and
 20 opens the circuit of relay 331 which releases, in turn releasing relays 334, 1410 and 1114. Relay 310 at its left outer front contact also closes a circuit extending from ground over conductor 1426, upper contacts of cam 1403,
 25 left upper contact of cam 1415, to battery through the winding of sequence switch magnet 1400 for advancing the sequence switch into position 14. Upon leaving the position 12, the holding circuit of relay 324 is opened
 30 and relay 324 releases, in turn releasing relay 310. Relay 1114 upon releasing releases all operated relays of the coin control circuit thereby preparing the coin control circuit for use on another connection.

35 With sequence switch 1400 in position 14 and relay 324 released, relays 301 and 1421 again operate under the control of timing circuit 1416 for advancing sequence switch 1400 into position 15, whereupon relays 301
 40 and 1421 release.

The arrival of switch 1400 in position 15 marks the end of the conversation period for which the coin has been collected and a test is now made to determine whether the subscriber is still on the line and, if so, whether
 45 he has deposited another coin. In position 15, therefore, talking battery and ground is removed from the line at cams 1404 and 1405, respectively, and a circuit is closed for relay 1442 extending from battery through the
 50 winding of relay 1442, left lower and right upper contacts of cam 1443, lower left winding of repeating coil 1338, bottom inner back contact of relay 1339, right upper contact of
 55 cam 1316, winding of relay 1317, right outer back contacts of relay 324, brush 325, terminal 326, conductor 116, subscriber's station transmitter to the windings of the magnet of coin box 140. If now, the subscriber is still on the
 60 line and has deposited another coin, the above circuit is completed to coin box ground causing relay 1442 to operate. Relay 1442 closes an obvious circuit for relay 1444, which, in operating, locks over its right outer contact,
 65 left lower contact of cam 1441 to an afore-

traced ground on conductor 1422 and further closes a circuit for relay 1410 extending from ground on conductor 1422, left lower contact of cam 1414, left lower contact of cam 1413,
 70 left middle contacts of relay 1444, left lower and right upper contacts of cam 1431, winding of relay 1410, right contacts of cam 1411, conductor 1412, resistance 330 to battery. Relay 1410 operates and closes a circuit extending from battery through the winding of
 75 magnet 1400, upper right contact of cam 1415, upper contacts of cam 1403, left outer front contact of relay 1410, right lower contact of cam 1441, to aforetraced ground on conductor 1422. Switch 1400 is advanced by this circuit to position 17, position 16 being a pass-by
 80 position. In position 16 another circuit is closed to magnet 1400 extending from ground on conductor 1422, left lower contact of cam 1414, left lower contact of cam 1413, left
 85 middle contacts of relay 1444, left lower contact of cam 1415, winding of magnet 1400 to battery. The sequence switch is now advanced to position 1 and talking battery and ground are reconnected to the line at cams
 90 1404 and 1405, respectively, for reestablishing the talking circuit between the two subscribers.

If, however, no coin is deposited, then when switch 1400 reaches position 15, the circuit of relay 1442 will not be completed at
 95 coin box ground as above described and, therefore, relay 1442 will not operate. Relay 1444 will likewise remain normal. When the switch advanced out of position 13 as above described, the locking circuit of relay 323 was opened at the left upper contact of cam 1441 and this relay released. In position 15, therefore, in the event that relays
 100 1442 and 1444 do not operate, a circuit is closed extending from ground on top contact of interrupter 341, back contacts of relay 323, left lower and right upper contacts of cam 1315, conductor 1437, upper contacts of cam 1440, conductor 313, winding of relay
 110 301, conductor 312, lower contact of cam 1401, conductor 1420, to battery through resistance 1342. Relay 301 operates and locks over a circuit extending from ground on brush 305, commutator 304, front contact of relay 301, conductor 314, left lower contact of cam 1402, winding of relay 1421, upper contacts of cam 1418, conductor 1419, left back contact of relay 324, conductor
 115 1439, to the upper contact of cam 1440 and thence as traced to battery through resistance 1342. Relay 1421, however, does not operate due to the shunting effect of interrupter 341 but does operate in series with the locking circuit of relay 301, when said interrupter opens its contacts. An operating circuit is now closed for relay 1410 extending from ground on the contact of relay 1421, left lower and right upper contacts of cam
 120 1431, winding of relay 1410, right contacts
 125
 130

of cam 1411, conductor 1412, resistance 330 to battery. A circuit is now closed from battery through the winding of sequence switch magnet 1400, upper right contact of cam 1415, upper contacts of cam 1403, left outer front contact of relay 1410, lower right contact of cam 1441, to ground on conductor 1422. Switch 1400 is now advanced to position 17, position 16 being a pass-by position.

In position 17 another operating circuit is closed for relay 301 extending from battery through resistance 1342, conductor 1420, lower contact of cam 1401, conductor 312, winding of relay 301, conductor 313, upper left contact of cam 1440, conductor 1439, left back contacts of relay 324, conductor 1419, lower right contact of cam 1425, to ground on the left inner contacts of relay 1410. Relay 301 operates and closes a circuit for lamp 1344 at the coin monitor operator's position extending from battery through lamp 1344, conductor 1428, left back contact of relay 1444, lower right contact of cam 1402, conductor 314, front contact of relay 301, commutator 304, to ground on brush 305. The lighting of lamp 1344 is a signal to the operator that the allotted period of conversation for the initial coin deposit has elapsed, that the subscriber is still on the line and that, in disregard of the tone warning signal transmitted at the time the original coin was collected, he has not deposited another coin. The operator thereupon proceeds to plug a connecting cord circuit into the overtime jack 1345 for the purpose of requesting an additional deposit by the calling subscriber if he desires to continue the conversation for another period. In the meanwhile relay 1410 closes another operating circuit for relay 323 extending from battery through the winding of relay 323, conductor 1427, upper contact of cam 1425, to ground in the left inner contact of relay 1410. The operation of relay 323 prevents interrupter 341 from being effective in shunting down relay 1421 should the switch slip in advancing from position 15 to 16. With the plug of the cord circuit (not shown) in jack 1345, a circuit is established from battery over the sleeve of the plug and sleeve of jack 1345, conductor 1429, upper left and lower right contacts of cam 1411, winding of relay 1410, upper right contact of cam 1413, lower left contact of cam 1414, conductor 1422 to ground at the left contacts of cam 1343. A circuit is also closed from the cord circuit over the tip of jack 1345, conductor 1430, upper left and lower right contacts of cam 1431, resistance 1432, winding of relay 1421, left upper and right lower contacts of cam 1418, conductor 1433, the ring of jack 1345 to the cord circuit thereby operating relay 1421 from battery supplied from the cord circuit. Relay 1421 upon operating ad-

vances sequence switch 1400 to position 18 thereupon releasing relays 301 and 1421 and extinguishing the lamp 1344. Relay 1410 upon operating removes at its left back contact the talking ground supplied to the calling line over the upper left winding of repeating coil 1338, the lower right contact of cam 1405, left back contact of relay 1410 and the right contact of cam 1407, whereby the current flowing over the calling line and the left windings of repeating coil 1338 is attenuated in the manner previously described, and when switch 1400 reaches position 18 the calling line is extended over the lower contact of cam 1318, the lower contacts of cam 1403, conductor 1430, tip of jack 1345 to the operator's cord circuit thence to the ring of jack 1345, conductor 1433, lower contacts of cam 1434, upper right contact of cam 1316, thence over the calling line loop. The calling subscriber is now supplied with talking battery and ground from the operator's cord circuit.

If the calling subscriber elects to continue the conversation and deposits another coin, the operator removes the cord from jack 1345, thus causing the release of relay 1410. Relay 1410 upon releasing advances sequence switch 1400 to normal over a circuit from battery, winding of magnet 1400, upper right contact of cam 1415, conductor 1435, lower back contact of relay 1339, right back contact of relay 1410, right upper and left lower contacts of cam 1414, conductor 1422, to ground over the right contacts of cam 1343. In normal position 1, the subscriber's line loop is extended through the winding of relay 1317 and the left windings of repeating coil 1338 to battery and ground at the contacts of cams 1404 and 1405 and since the calling subscriber has elected to continue the conversation relay 1317 reoperates over a previously described path. A circuit is now established from battery through the winding of relay 302, lower contacts of interrupter 1341, upper left and lower right contacts of cam 1327, conductor 1406, left contacts of cam 1407, conductor 1408, front contact of relay 1340, to ground at the upper right contact of cam 1304. Relay 302 operates and locks over its inner right front contact, the lower contact of cam 1302, and thence to ground at the upper right contact of cam 1304 and closes a circuit for relay 1410 extending from ground as traced to conductor 1406 thence over the lower right and upper left contacts of cam 1327, upper contact of interrupter 1341, outer right front contact of relay 302, lower right contact of cam 1303, conductor 1409, winding of relay 1410, right contacts of cam 1411, conductor 1412, resistance 330 to battery. Relay 1410 operates locking over a circuit extending from battery, conductor 1412, right contacts of cam 1411, winding of relay 1410, right

upper contact of cam 1413, upper left contact of cam 1414, outer left front contact of relay 1410, lower left contact of cam 1407, conductor 1408, front contact of relay 1340 to ground at the upper right contact of cam 1304 and establishes a circuit for advancing sequence switch 1400 to position 2 which may be traced from battery through the winding of magnet 1400, lower right contact of cam 1415, conductor 1419, left back contact of relay 324, conductor 1439, left lower contact of cam 1440, to ground on the inner left contact of relay 1410. When sequence switch 1400 leaves position 1, relay 1410 releases, and the locking circuit of relay 302 is opened at the right contact of cam 1407. Sequence switch 1400 is thereupon advanced into position 12 under control of timing circuit 1416 and relays 301 and 1421 to measure off an additional five minutes for conversation. The coin control circuit is again taken for use, the deposited coin is collected, warning tone sent out to the subscriber and, after its collection, the operator is again signaled in the manner previously described if the subscriber has failed to deposit an additional coin. These functions are thereafter repeated so long as the calling subscriber signifies that he wishes to continue the conversation by failing to restore at the end of any conversation periods.

If when the operator requested the calling subscriber to either deposit an additional coin or to hang up he does neither, the operator may then plug a second cord circuit into the splitting jack 1346. As soon as sequence switch 1400 advances to position 18 when the operator connected a first cord circuit with jack 1345, a circuit is established from battery over the sleeve of jack 1346, winding of relay 1339, lower contacts of cam 1414, conductor 1422 to ground over the left contacts of cam 1343. With relay 1339 operated, the talking circuit between the subscribers is interrupted and the called subscriber is connected over front contacts of relay 1339 and jack 1346 with the operator's cord circuit. The operator may then instruct the called subscriber to wait on the connection while an attempt is being made to obtain a second deposit from the calling subscriber. If the calling subscriber, however, disconnects, the operator will then inform the called subscriber accordingly and remove the cord plug from the splitting jack 1346 and the other cord plug from the monitoring jack 1345. With both plugs removed, the sequence switch 1400 will advance in the manner described to position 1. As soon as the subscribers have both deenergized, relay 323 releases as soon after the release of relay 1317 as interrupter 341 opens its lower contact, and opens the holding circuit of relay 323

which extends from battery through the winding of relay 323, lower contacts of cam 1333, right contact of relay 323 to ground at the lower contacts of interrupter 341. As soon as interrupter 341 again closes its contacts with relay 323 released, a circuit is established from ground at interrupter 341, left back contact of relay 323, lower left and upper right contacts of cam 1315, conductor 1437, lower contacts of cam 1403, conductor 339 to battery through the left winding of relay 324. Relay 324 upon operating transfers the talking conductors of the calling line to conductors extending to terminals of coin control circuit and locks in a circuit extending from battery through its right winding, upper contacts of cam 1434, conductor 332, left front contact of relay 324 to ground at the upper right contact of cam 1311. This locking circuit is extended over the right normal contacts of relay 310 to battery through the winding of relay 331. Relay 331 functions in the manner previously described to cause an idle coin control circuit to become associated with the line finder district selector link, whereupon relays 334 and 1114 operate in the manner previously described. Relay 334 upon operating performs the functions previously described and, in addition, establishes a circuit from ground at its right front contact, conductor 1423, left contacts of cam 1424, conductor 1445, lower left and upper right contacts of cam 1301, to battery through the winding of sequence switch magnet 1300 thereby advancing sequence switch 1300 to position 17. With sequence switch 1300 in position 17 and relay 334 operated, a circuit is closed for relay 302 extending from battery, winding of relay 302, left contacts of cam 1301, conductor 1445, left contacts of cam 1424, conductor 1423, to ground at the outer right front contact of relay 334. Relay 302 upon operating locks over its inner right front contact, the right contacts of cam 1302, to ground over line finder commutator segment 342 and brush 343.

Since the sequence switch 1400 is in normal position at this time, when relay 114 operates upon the connection of the coin circuit with the line finder district link, the circuit previously traced for relay 1125 is not closed and when thereafter relays 1117, 1118, 1121 and 1124 function in the manner previously described, current is applied to the conductors of the calling line from the 110 volt source of negative coin refunding potential through ballast lamp 1130, outer right front contact of relay 1124, left back contact of relay 1125, winding of relay 1126, right contact of relay 1117, right and middle windings of tone coil 1137, left front contacts of relay 1121, over the calling line conductors thence to ground through the coin

box 140 if a coin is present in the coin box. This application of refunding potential will thereupon cause any deposited coin to be refunded. The coin circuit then functions as previously described to operate relay 1119 in turn operating relay 310. Relay 310 upon operating locks over its right winding and right inner front contact, inner left contact of relay 324 to ground at the upper right contact of cam 1311, and releases relays 331 and 1114, thereby releasing the coin circuit and also releases the calling line cut off relay 102. As the calling line is equipped with message register 105 a circuit is established with sequence switch 1300 in position 17 and sequence switch 1400 in position 1 from ground through register 105, left back contact of relay 101, conductor 114, terminal 309, brush 308, right back contact of relay 310, conductor 311, left contacts of cam 1343, inner right front contact of relay 329 to battery through resistance 330.

With relays 302 and 310 operated, a circuit is established for advancing sequence switch 1300 to position 18 which may be traced from battery, winding of magnet 1300, upper right contact of cam 1305, outer right front contact of relay 302, inner left front contact of relay 310 to ground at the upper left contact of cam 1324. In position 18 the locking circuit of relay 310 is opened in turn releasing relay 324 and a circuit is established for the down-drive magnet 344 of the line finder extending from battery through the winding of magnet 344, lower left contact of cam 1303, outer right front contact of relay 302 to ground at the upper left contact of cam 1304 for restoring the shaft of the line finder to normal. When the line for finder reaches its normal position, the locking circuit of relay 302 is opened at commutator brush 343 and segment 342 and relay 302 releases opening the circuit of the down-drive magnet. A circuit is also closed from battery through winding of down-drive magnet 1347 of the district selector, left contacts of cam 1436, lower right and upper left contacts of cam 1312 to ground over the right contacts of cam 1307 for driving the district selector shaft to normal. When it reaches normal, sequence switch 1300 is advanced to normal over a circuit extending through the winding of magnet 1300, lower right contact of cam 1314, left upper and right lower contacts of cam 1443, conductor 1435, normal commutator segment 1348, brush 1332 to ground at the lower contact of cam 1311. Upon leaving position 16 1/4 ground is removed from test terminal 1330 at the right contact of cam 1328 and the release of all selector switches beyond the district selector is thus initiated. All apparatus used in the establishment of the connection is now restored to normal.

Talking to an operator

In the preceding description it was assumed that the call was a charge call and that sequence switch 1300 was, therefore, set into either talking selection position 13 or 14. It will now be assumed that the call is to an operator's position and that, therefore, sequence switch 1300 is set into position 15. When the operator answers, relay 1340 operates and establishes a circuit for relay 321 extending from battery through the left winding of relay 321, lower contacts of cam 1327, conductor 1406, left contacts of cam 1407, conductor 1408, front contact of relay 1340 to ground at the upper right contact of cam 1304. Relay 321 operates and locks over its right winding and inner right front contact, upper right contact of cam 1307, right contact of cam 1328, brush 1329 to ground on the sleeve of the trunk circuit extending to the operator's position and closes a circuit for advancing sequence switch 1300 to position 16, which circuit may be traced from battery through the winding of magnet 1300, upper left contact of cam 1314, left front contact of relay 321 to ground at the lower right contact of cam 1304.

With sequence switch 1300 in position 16, the right windings of repeating coil 1338 and the winding of relay 1340 are disconnected at the left contacts of cam 1335 and 1336 from the trunk circuit extending to the operator's position and the conductors of the calling line are connected in a metallic circuit over the upper right contact of cam 1318 and the lower right contact of cam 1316 directly to brushes 1334 and 1337, and thence over the trunk circuit to the operator's cord circuit, and the sleeve conductor 112 of the calling line is extended over terminal 319, brush 320, the lower left and upper right contacts of cam 1328, sleeve brush 1329 to the operator's trunk for check tone testing purposes.

When the operator disconnects and the calling subscriber replaces his receiver on the switchhook relays 321 and 1317 release, relay 321 advancing sequence switch 1300 into position 17 over a circuit extending from battery, winding of magnet 1300, lower contacts of cam 1322, left back contact of relay 321 to ground at the lower right contact of cam 1304. Until sequence switch 1300 passes beyond position 16 1/4, the operator's trunk is held busy over the right contact of cam 1328, the upper right contact of cam 1307, the right back contact of relay 321 to ground at the left contact of cam 1311. The line finder district selector link circuit then functions in the manner previously described to cause the association of a coin control circuit therewith for the purpose of refunding a deposited coin and thereafter the operated circuits are all released in the manner previously described.

Failure to collect or refund a deposited coin

It will be recalled that following the application of coin collecting current or coin refunding current from the coin control circuit of Fig. 11 to the coin box 140 of the calling line, relay 1128 in the coin circuit connected the windings of relay 1134 to the talking conductors of the calling line for the purpose of testing to determine if the coin has been released from the coin chute of the box either into the collection till or into the return chute. If the coin is not properly released and the calling subscriber has not hung up, ground will be connected at the coin box 140 to the conductors of the calling line, thus operating relay 1134. Relay 1134 upon operating closes a circuit for relay 1135, extending from ground at the front contact of relay 1134 over the normal contacts of release jack 1138 to battery through the winding of relay 1135 and relay 1135 in turn closes a circuit from ground at the outer left front contact of relay 1114 over the inner left front contact of relay 1135 to battery through the winding of relay 1133. Relay 1133 upon operating closes a holding circuit for relay 1135 extending from battery through the winding of relay 1135, right back contact of relay 1119, inner left front contact of relay 1133 to ground at the outer left front contact of relay 1114 and establishes an operating circuit for signal lamp 1131 extending either from ground at the right back contact of relay 1125, right front contact of relay 1133, normal contacts of monitoring jack 1132 to battery through lamp 1131 or from ground at the outer front contact of relay 1118, thence as traced to battery through lamp 1131, whereby the lamp burns steadily if the coin sticks when refund current is applied to the coin box or flashes through the operation and release of relays 1117 and 1118 if the coin sticks when coin collection current is applied to the coin box. Relay 1133 also opens the locking circuits of relays 1117, 1118 and 1124 at its inner left normal contacts.

When the monitoring operator answers in response to the stuck coin signal given by the lamp 1131, relay 1119 operates over a circuit from ground through its right winding inner right contact of relay 1135, sleeve of jack 1132 to battery on the sleeve of the operator's cord circuit (not shown). Relay 1119 upon operating locks over its left winding and middle left front contact to ground at the outer left front contact of relay 1114 and connects battery through resistance 1136, outer left front contact of relay 1135, outer left front contact of relay 1119 to test brush 1102 for test purposes. The operator may now talk to the calling subscriber for the purpose of having the subscriber attempt to dislodge the stuck coin. If the operator is successful in clearing the coin and desires to release the coin control circuit and associated district selector,

she may do so by removing the plug of her cord circuit from the monitoring jack and inserting it in the release jack 1138, thereby releasing relays 1135 and 1133. With relay 1135 normal and relay 1119 operated, ground is connected from the outer left front contact of relay 1114, left back contact of relay 1135, outer left front contact of relay 1119, brush 1102, conductor 340 to battery through the left winding of relay 310, whereupon the connection is released in the manner previously described.

Charge call with no coin present

If relay 1126 fails to operate when relay 1125 is operated and coin collecting current is applied to the coin box 140 through the winding of relay 1126, and consequently relay 1122 does not operate, a circuit is established from ground at the outer left front contact of relay 1114, back contact of relay 1122, inner left front contact of relay 1123, middle right front contact of relay 1125, right contacts of relay 1119, normal contacts of release jack 1138 to battery through the winding of relay 1135. Relay 1135 operates, causing relay 1133 to operate, thereby locking relay 1135, releasing relays 1117, 1118 and 1124 and closing the flashing circuit for lamp 1131 in the manner previously described. The release of the connection then proceeds in the manner previously described in the preceding paragraph.

Early release of connection

Should the calling subscriber hang up to abandon the call before or during group selection by the district selector, the district selector sequence switch 1300 will be in some position between 3 and 6. When the calling subscriber opens his line loop relay 606 of the sender releases in turn releasing relays 609 and 610. The release of relay 610 closes a circuit for relay 526 extending from battery through the winding of relay 526, outer left back contact of relay 504, brush 660 of switch 600, outer left front contact of relay 601, left normal contact of relay 610, back contact of relay 606 to ground at the inner left back contact of relay 515. Relay 526 upon energizing locks through its left front contacts to ground at the inner left front contact of relay 507, and closes an obvious circuit for relay 515. Relay 515 at its outer right front contact shunts the right winding of relay 503 increasing the current flowing through the left winding of relay 324 of the district selector, whereby relay 324 energizes and locks from battery through its right winding, upper contacts of cam 1434, conductor 332, inner left front contact of relay 324 to ground at the upper right contact of cam 1311. The locking ground for relay 324 is also extended over the right normal contacts of relay 310 to battery through the winding of relay 331 operating relay 331.

Relay 331 upon operating causes the association of an idle coin control circuit with the line finder district selector link circuit in the manner previously described and since relay 1125 of the coin circuit has not been operated, the deposited coin is refunded and the coin circuit is dismissed. Relay 331 upon operating also establishes a circuit for relay 302 extending from battery through the winding of relay 302, left contacts of cam 1301, conductor 1445, left contact of cam 1424, conductor 1423, middle left front contact of relay 331 to ground at the left back contact of relay 329. The operation of relay 302 connects battery through resistance 1342, over its outer left front contact, left contact of cam 1426, lower right contact of cam 1315 to the circuit previously traced through the left winding of relay 415 to ground through the windings of relay 503, in parallel with the left winding of relay 324 and the winding of relay 323, thus causing relay 415 to operate and advance the link circuit sequence switch out of position 5 to release the sender. Relay 302 also establishes a circuit for advancing sequence switch 1300 into position 7 extending from battery through winding of magnet 1300, upper right contacts of cam 1305, outer right front contact of relay 302 to ground at the upper left contact of cam 1304 and locks over its inner right front contact, lower right and upper left contacts of cam 1302, back contact of relay 301 to ground over commutator segment 304 and brush 305. This locking circuit is maintained after sequence switch 1300 reaches position 7.

With sequence switch 1300 in position 7, a circuit is established for the down-drive magnet 1347 of the district selector extending from battery through the winding of magnet 1347, lower right contact of cam 1305, outer right front contact of relay 302 to ground at the upper left contact of cam 1304, thereby driving the district selector switch shaft into normal position. Relay 323, being operated at this time, closes an additional holding circuit for relay 302 extending from battery through the winding and inner right front contact of relay 302, upper right and lower left contacts of cam 1333, right front contact of relay 323 to ground at the lower left contact of cam 1324, thus holding relay 302 operated until sequence switch 1300 leaves position 8. When the district selector reaches normal a circuit is established for advancing sequence switch 1300 into position 8 extending from battery through the winding of magnet 1300, lower right contact of cam 1314, left upper and right lower contacts of cam 1443, conductor 1435, normal segment 1348 and brush 1332 to ground at the lower contact of cam 1311.

As soon as the link sequence switch 400 advances beyond position 5, relay 323 re-

leases, in turn releasing relay 302. A circuit is now established for advancing sequence switch 1300 to position 9 extending from battery, winding of magnet 1300, lower contacts of cam 1322, left back contact of relay 321, outer right back contact of relay 302 to ground at the upper left contact of cam 1304. From position 9 sequence switch 1300 is advanced into position 17 over the circuit which advanced it out of position 7. With sequence switch 1300 in position 17 and with relay 331 operated to seize the coin control circuit or with relay 334 operated after the coin circuit has been seized or with relay 310 operated after the dismissal of the coin circuit, relay 302 is operated in a circuit extending from battery through its winding, left contacts of cam 1301, conductor 1445, left contact of cam 1424, conductor 1423 to ground at the right front contact of relay 334 or to ground over the middle left front contact of relay 331 and the left back contact of relay 329. If relay 310 is operated, then the circuit of relay 302 extends over the upper contacts of cam 1424, conductor 1426 to ground at the outer left front contact of relay 310. Relay 302 locks over its inner right front contact, right contacts of cam 1302 to ground on commutator segment 342 and brush 343 and closes a circuit for advancing sequence switch 1300 into position 18 extending from battery through the winding of magnet 1300, upper right contact of cam 1305, outer right front contact of relay 302, inner left front contact of relay 310, provided the coin control circuit has functioned, to ground at the upper left contact of cam 1324. Sequence switch 1300 is then advanced into normal position 1 over the circuit previously traced through normal segment 1348 of the district selector commutator. With sequence switch 1300 in position 1, a circuit is established for the down-drive magnet 344 of the line finder extending from battery through magnet 344, lower left contact of cam 1303, right front contact of relay 302 to ground at the upper left contact of cam 1304. When the line finder reaches normal, the locking circuit of relay 302 is opened at commutator segment 304 and relay 302 releases opening the circuit of the down-drive magnet. All apparatus is now in normal condition.

If the establishment of a connection has proceeded beyond district group selection and the district sequence switch 1300 is in some position beyond position 6, relays 324 and 331 operate in the manner described for the release of a connection prior to completion of district group selection and the coin control circuit is seized to refund the deposited coin. As the sequence switch 1300 passed through position 7 after district group selection, relay 321 operated from battery through its left winding, lower left contact

of cam 1327, left contact of cam 1302 to ground over commutator segment 342 and brush 343, advancing sequence switch 1300 to position 8. The release of relay 321 after the completion of trunk hunting advances sequence switch 1300 to position 9. In position 9 with relay 323 operated, a circuit is established for relay 321 extending over its left winding, left contacts of cam 1333, right contact of relay 323 to ground at the lower left contact of cam 1324. Relay 321 advances sequence switch 1300 to the selection beyond position 10 in the manner previously described. When relay 504 in the sender operates in the manner previously described to remove the shunt from the left winding of relay 503, relay 323 in the district selector releases in turn releasing relay 321. The release of relay 321 advances sequence switch 1300 to position 12 from which position it advances into position 17 under the control of relays 334 and 310 and the release of the circuit then proceeds as previously described.

What is claimed is:

1. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, a link circuit for establishing a talking connection between said calling line and said called line and a coin control device selectable by said link in response to said called line for operative association with said link circuit comprising means for collecting a coin deposited in said coin device and means for transmitting a signal to said calling line simultaneously therewith.

2. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, a link circuit terminating in a selector switch for extending said calling line to said called line, a plurality of identical coin control devices common to said link circuit, means responsive to the response of the called subscriber to cause one of said coin control devices to become associated with said link circuit, means in said coin control device for collecting a coin deposited in said coin device, and means in said coin control device for transmitting a signal to said calling line simultaneously with said collection.

3. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, a coin control device for collecting a coin deposited in said coin device, and a link circuit for establishing a talking connection between said calling and said called line comprising means for operatively connecting said coin control device to said link for the collection the said coin, means for testing said coin device for the presence therein of another coin after said collection and means for controlling said talking connection in accordance with said test.

4. In a telephone exchange system, a calling line, a called line, a coin device on said

calling line, a link circuit for establishing a talking connection between said calling line and said called line, a coin control device responsive to said called line for operative association with said link circuit for collecting a coin deposited in said coin device, means in said coin control device for transmitting a signal to said calling line simultaneously with said collection, means in said link responsive to said collection for testing said coin device for the presence therein of another coin and means in said link circuit for controlling said talking connection in accordance with said test.

5. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, a link circuit for establishing a talking connection between said calling line and said called line, a coin control device responsive to said called line for operative association with said link circuit for collecting a coin deposited in said coin device, means in said coin control device for transmitting a signal to said calling line simultaneously with said collection, means in said link circuit for testing said coin device after said collection for the presence therein of another coin, means in said link circuit for disrupting said talking connection during said test, and means in said link circuit responsive to said test if a coin is present in said coin device for reestablishing said talking connection.

6. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, an operator's position, a link circuit for establishing a talking connection between said calling line and said called line, said link circuit having a monitoring extension to said operator's position, a coin control device responsive to said called line for operative association with said link circuit comprising means for collecting a coin deposited in said coin device and means for transmitting a signal to said calling line simultaneously with said collection, means in said link circuit for testing said coin device after said collection for the presence therein of another coin and means responsive to said test if a coin is not present in said coin device for extending said calling line to said operator's position through said link circuit monitoring extension.

7. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, an operator's position, a link circuit for establishing a talking connection between said calling line and said called line, said link circuit having a monitoring extension to said operator's position, a coin control device responsive to said called line for operative association with said link circuit comprising means for collecting a coin deposited in said coin device and means for transmitting a signal to said calling line simultaneously with said collection, means in said link

circuit for testing said coin device after said collection for the presence therein of another coin, means in said link circuit for disrupting said talking connection during said test, means in said link circuit responsive to said test if a coin is deposited in said coin device for reestablishing said talking connection, and means in said link circuit responsive to said test if a coin is not deposited for extending said calling line to said operator's position through said line circuit monitoring extension.

8. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, a link circuit terminating in a selector switch for extending said calling line to said called line, a timing switch associated with said link, a plurality of coin control devices, a source of tone in each of said coin control devices, means responsive to the response of the called subscriber to start said timing switch in a first cycle to measure a prescribed period of conversation, means controlled by said timing switch to cause one of said coin control devices to become operatively associated with said link circuit for collecting a deposited coin, means controlled by said timing switch near the end of its cycle for operating said coin control device to collect said coin and to connect simultaneously therewith said source of tone to said calling line, means responsive to the disposal of said coin for dissociating said control device from said link circuit, means in said timing switch for testing said coin device for the presence of another coin therein and means responsive to said test for causing the said timing switch to complete a second cycle for reassociating one of said control devices with said link circuit for collecting said second coin and for connecting said source of tone to said calling line.

9. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, a link circuit terminating in a selector switch for extending said calling line to said called line, a timing switch associated with said link circuit, a plurality of coin control devices, a source of tone in each of said coin control devices, means responsive to the response of the called subscriber to start said timing switch in a first cycle to measure a prescribed period for conversation, means controlled by said timing switch to cause one of said coin control devices to become operatively associated with said link circuit for collecting a deposited coin and for connecting said source of tone to said calling line simultaneously therewith, means responsive to the disposal of the deposited coin for dissociating said control device from said link circuit, means in said timing switch for testing said coin device for the presence therein of another coin and means for causing said timing

switch to complete additional cycles for measuring overtime periods of conversation and for causing the repeated association of one of said coin control devices with said link circuit if said calling subscriber deposits an additional coin for each such overtime period.

10. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, a coin control device for collecting a coin deposited in said coin device, and a link circuit for establishing a talking connection between said calling and said called lines comprising means for operative connection with said coin control device for the collection of said coin, means for measuring a time interval after the collection of said coin, means for testing said coin device for the presence therein of another coin after said timing interval and means for maintaining said talking connection during said interval.

11. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, a coin control device for collecting a coin deposited in said coin device, a link circuit for establishing a talking connection between said calling and said called lines, means in said link circuit for operative connection with said coin control circuit for the collection of said coin and a timing device in said link circuit comprising means responsive to the collection of said coin for measuring a timing interval, means for maintaining said talking connection during said timing interval, means for testing said coin device for the presence therein of another coin after said interval has lapsed, and means for controlling said talking connection in accordance with said test.

12. In a telephone exchange system, a calling line, a called line, a coin device on said calling line, a coin control device for collecting a coin deposited in said coin device, a source of tone in said coin control device, a link circuit for establishing a talking connection between said calling and said called lines, means in said link circuit for operative connection with said coin control circuit for the collection of said coin and for the simultaneous connection of said source of tone to said calling line, and a timing device in said link circuit comprising means responsive to the collection of said coin for measuring a timing interval, means for maintaining said talking connection during said timing interval, means for testing said coin device for the presence therein of another coin after said interval has elapsed and means for controlling said talking connection in accordance with said test.

In witness whereof, I hereunto subscribe my name, this 25th day of March 1932.

ALFRED E. HAGUE.