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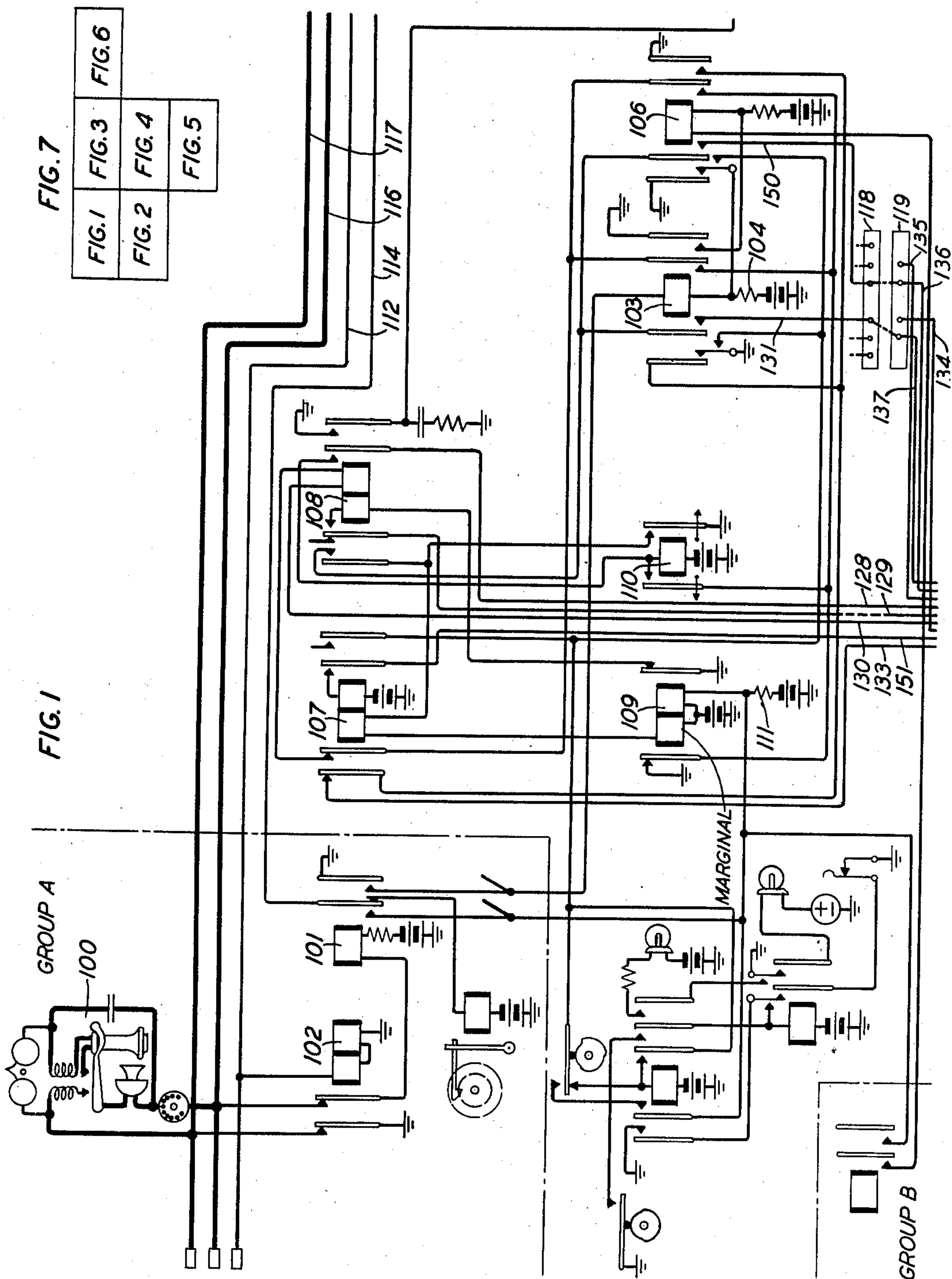
A. RAYNSFORD ET AL

1,944,269

TELEPHONE SYSTEM

Filed April 15, 1932

6 Sheets-Sheet 1



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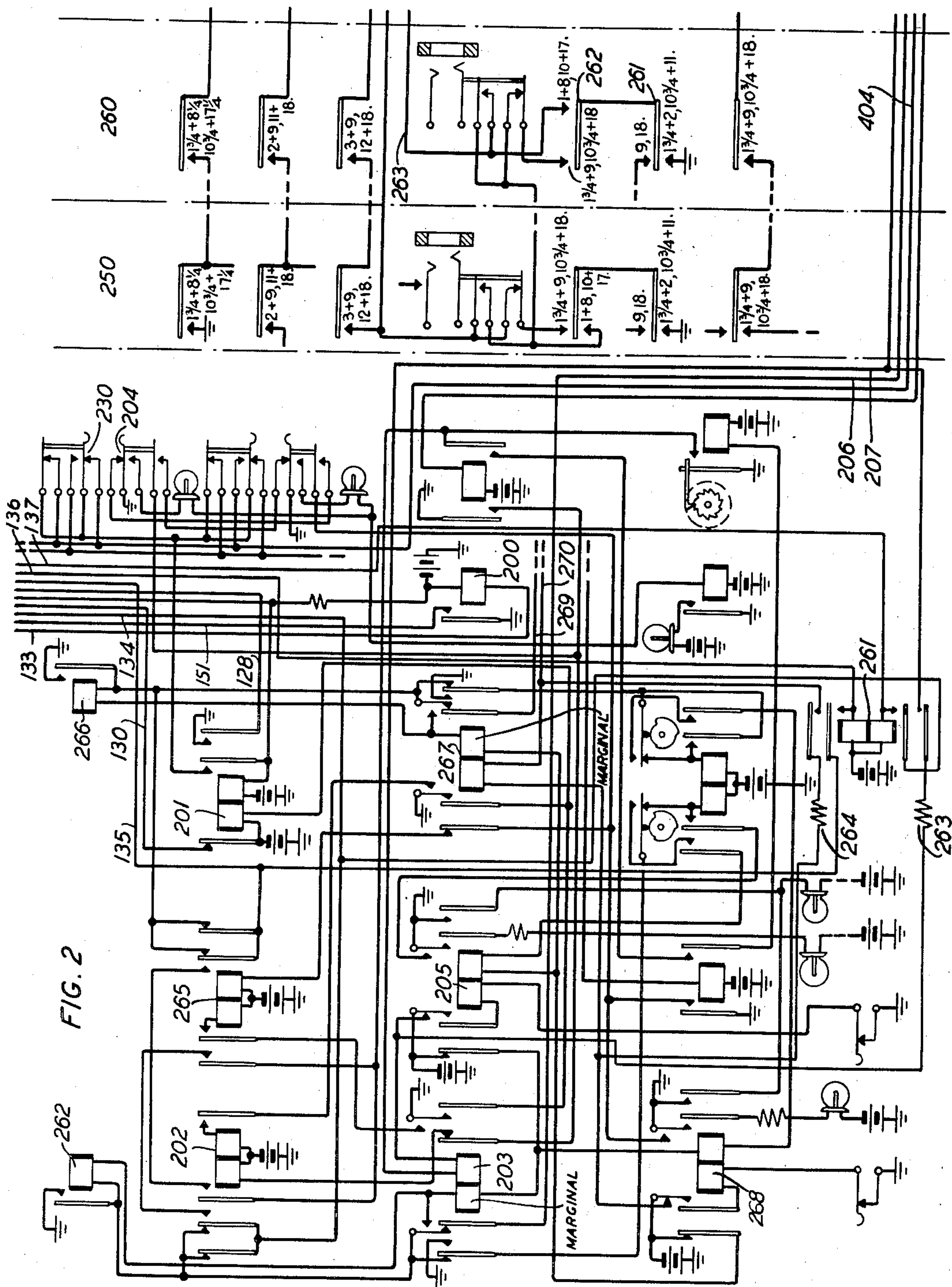
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6 Sheets-Sheet 2



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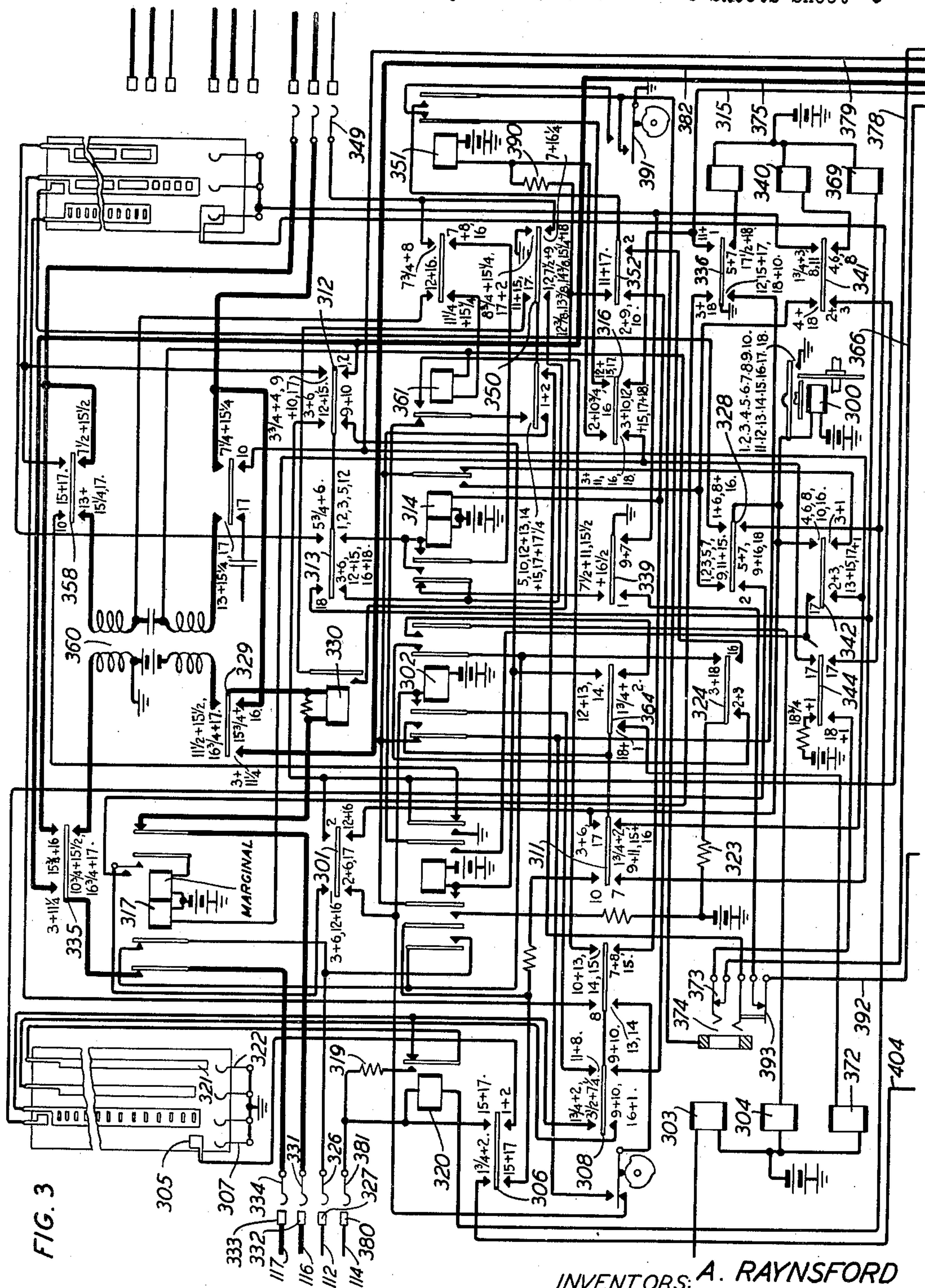
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6 Sheets-Sheet 3



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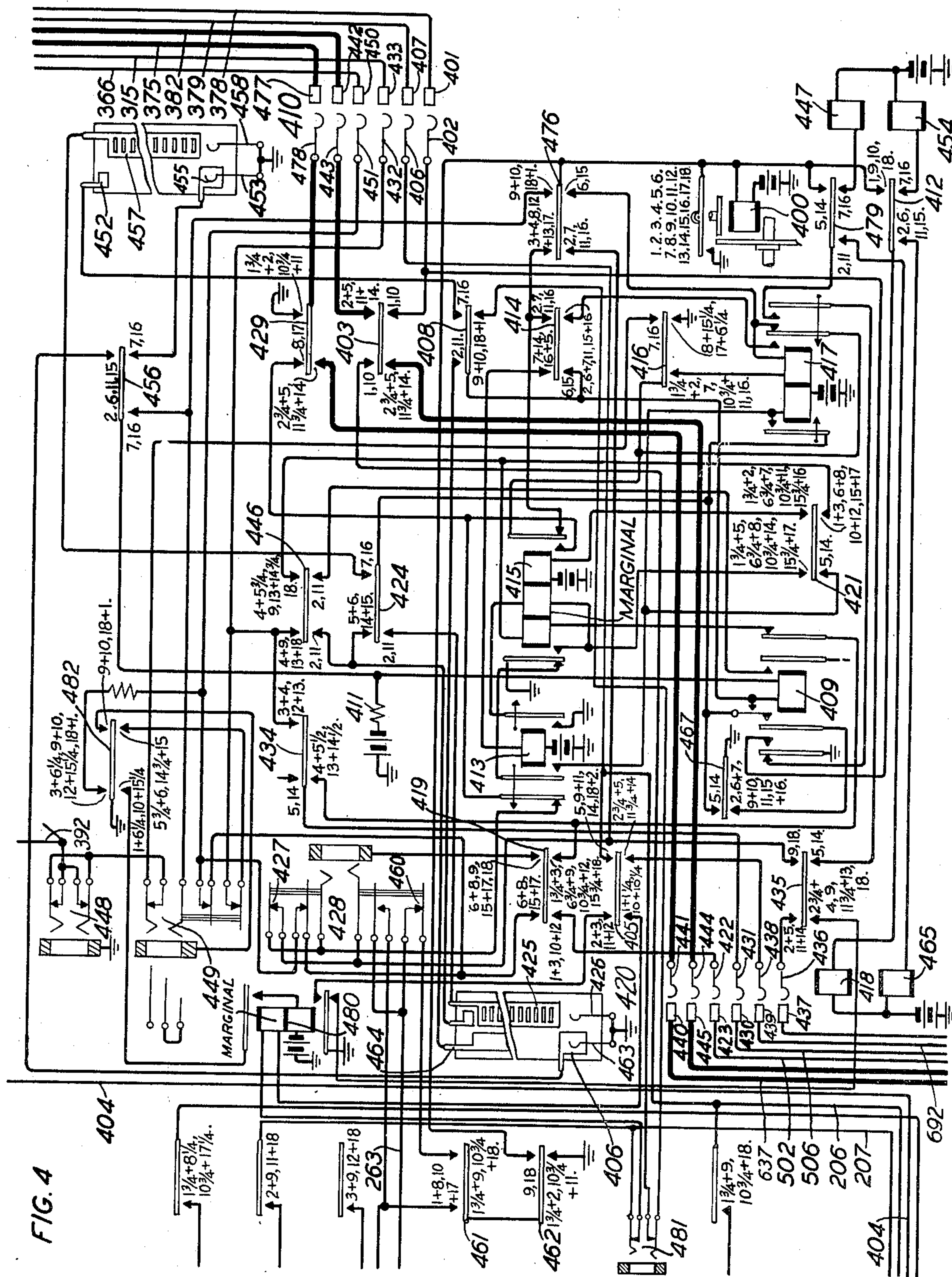
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TELEPHONE SYSTEM

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6 Sheets-Sheet 4



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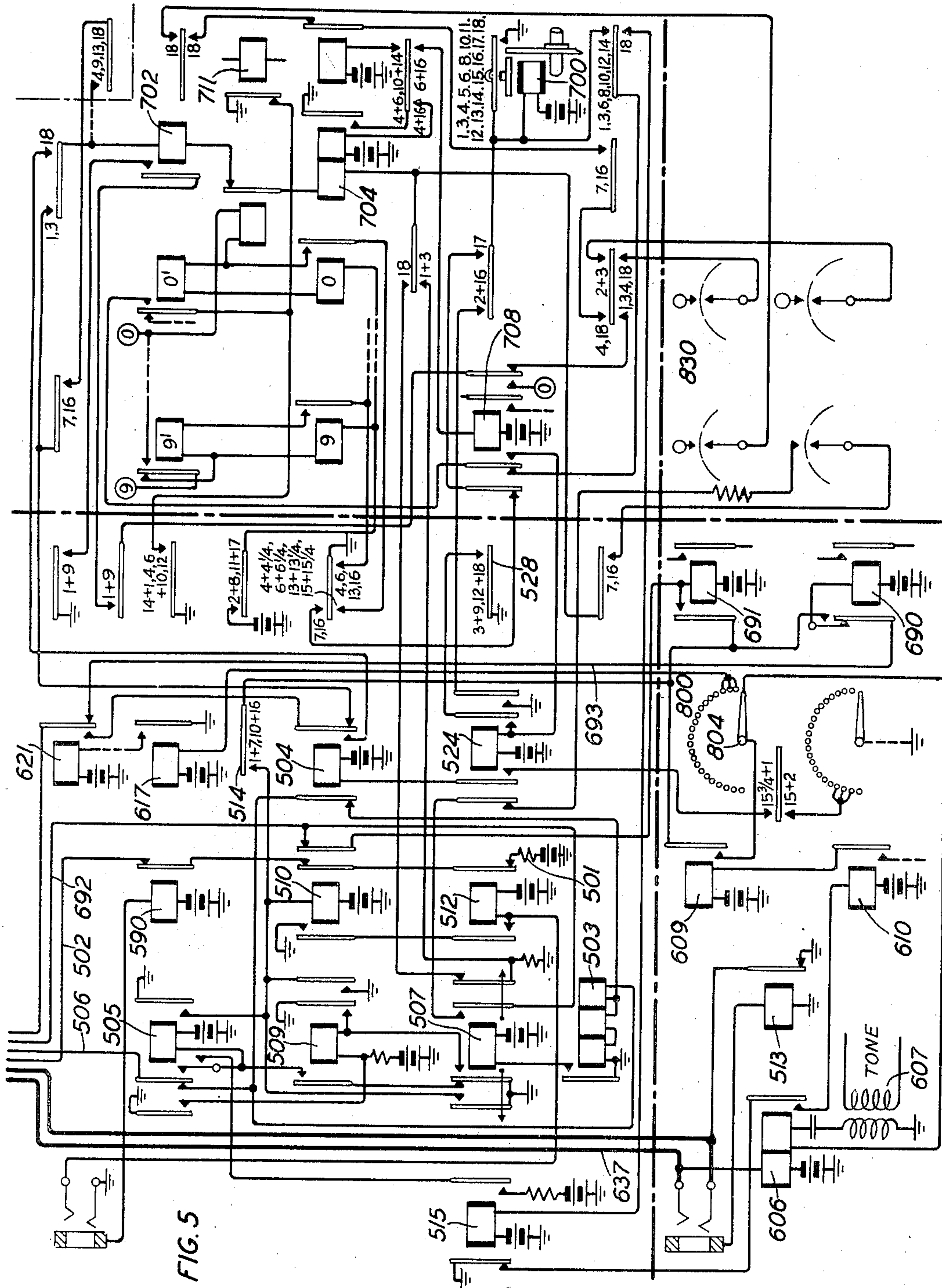
A. RAYNSFORD ET AL

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TELEPHONE SYSTEM

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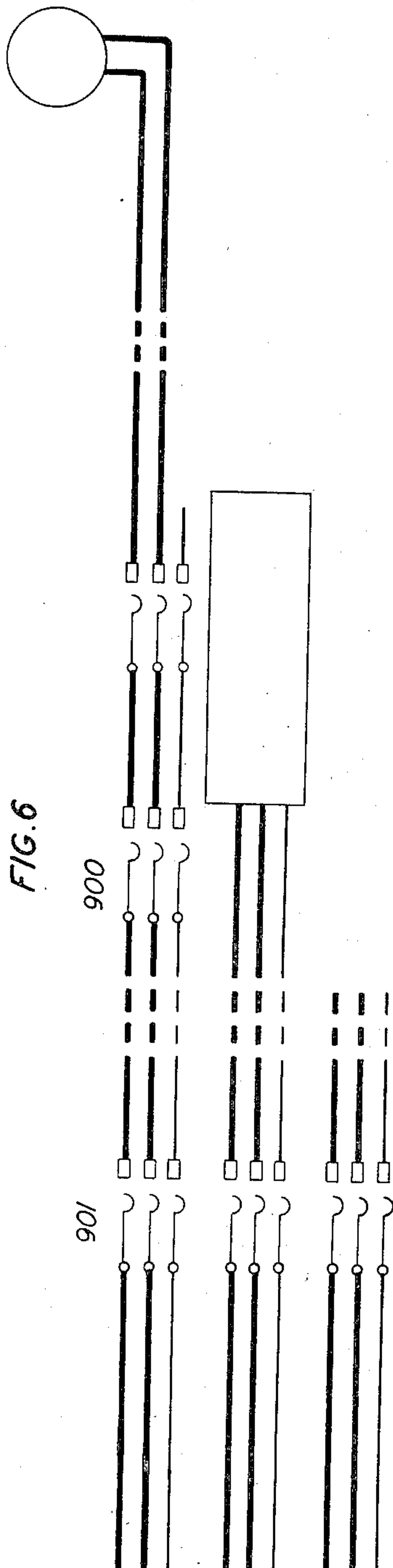
A. RAYNSFORD ET AL

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TELEPHONE SYSTEM

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6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

1,944,269

TELEPHONE SYSTEM

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Application April 15, 1932. Serial No. 605,410

9 Claims. (Cl. 179—27)

This invention relates to telephone systems and more particularly to automatic telephone exchange systems using links for connecting calling lines with selection control devices such as register senders.

The object of the invention is the provision of a link circuit capable of discriminating between calling lines of different classes, thereby permitting the use of one group of links for a number of different classes of subscribers.

As is well known in present day telephone systems, there is a considerable diversity in the lines of an office with respect to their class or character and the character of service each of said classes is to be accorded. Some of the lines may be provided with coin boxes at the subscriber's stations and, in serving such a line, the central office automatic equipment must be provided with means for collecting the coin if the connection is completed or to return the coin if the connection is not completed. Another class of lines may involve the writing of a charge ticket by the operator to whose position the call is routed by the automatic apparatus; another class may require the automatic operation of the subscriber's message register a plurality of times on a toll call requiring no ticket and completed by automatic switches. Yet another class of lines may be given a so-called flat rate and in that case the switching selectors which complete the call are not required to operate the message register at all, if one is provided.

At the present time all the lines in an automatic office requiring different treatment are grouped in accordance with their respective classes, and a separate group of links or other line extending switches is assigned to each class, the said switches having access to a group of selection control devices, like register senders, whose function is to control the setting of the necessary stages for the proper disposition of the call as is determined by the impulse code dialed thereinto from the calling line and the designation of the class of service to which the calling line is entitled. In order to apprise the register sender of the class of the calling line, one of the commonly prevalent practices is to associate a distinctive electric condition on each link of the group serving a particular class and the subsequent connection of the link with a register sender causes variable circuits in the sender to respond to this distinctive condition in recognition of the class of said line. It is evident, however, that with such an arrangement one group of links is needed for each class, thereby, in the aggregate,

requiring a larger number of links than would otherwise be necessary if a common group were used for all classes. It is the particular object of the present invention, therefore, to make it possible to use one group of links for a number of different classes of subscribers and in its preferred embodiment, to illustrate how by means of our invention, one common group of links may be used by two different classes, thereby permitting a decided economy in the number of links required.

In accordance with the invention, therefore, one specific embodiment of which is disclosed herein by way of illustration, this is accomplished in the following improved manner: In order to simplify the detailed description of our invention, we have illustrated it with respect to the telephone system described in Patent No. 1,690,206 to Arthur Raynsford, granted November 6, 1928 which makes use of a link system of a well known type. It is understood, however, that our invention is not limited to any specific organization of circuits or any special type of apparatus, but may be applied by anyone skilled in the art to any automatic or semi-automatic telephone system for accomplishing the identical purpose described herein.

One major group of subscribers' lines is subdivided as heretofore into minor subgroups A and B and each major group is further divided into subgroup (a) and subgroup (b) in accordance with the class of service to which they are entitled and their lines terminate on line-finder bank contacts. The line-finder switches cooperating with said contacts are similarly divided into two minor groups A and B for preferential selections in the well known manner, and the seizure of line-finder switches of either minor group is controlled through a common start circuit responsive to a calling line. The start circuit contains a discriminating means accessible to the calling lines which is operated by the calling lines of subgroup (a) and not operated by those of subgroup (b). The link circuit is provided with a marginal relay which is responsive to said discriminating means when the link is associated with the start circuit. When, therefore, a call is initiated from a subscriber's line in one of the groups, and an idle link is operatively connected to the start circuit, the operation of the start circuit causes a circuit to be closed through the marginal relay in the link circuit. If, now, the calling line belongs to the subgroup for which the discriminating means is not operated, the marginal relay will remain in its non-operated condition. When the

link establishes connection with a control device such as a register sender, a circuit controlled by the non-operated condition of the marginal relay causes responsive devices in the sender to record the class of service indicated by the non-operated condition of said marginal relay. On the other hand, if the calling line belongs to the subgroup for which the discriminating means is operated, then the circuit for said marginal relay is altered by said discriminating means and said marginal relay operates. On the further operative connection of the link with the register sender, a circuit controlled by the operated condition of the marginal relay causes responsive devices in the sender to record the class of service indicated by the operated condition of the marginal relay. In this manner it is easily seen that one group of links may be used in common by two separate subgroups of subscribers' lines, each having different classes of service, thereby effecting a reduction in the number of links necessary if there were a separate group of links for each group of subscribers' lines.

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

Fig. 1 shows a calling subscribers' line together with certain relays for preventing interference between calling lines;

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

Fig. 3 shows a line finder and district selector;

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

Fig. 5 shows a portion of the register sender;

Fig. 6 shows in schematic form selectors for completing the connection to an automatic subscriber, to a manual office or to an operator; and

Fig. 7 shows the manner in which Figs. 1 to 6 should be arranged with respect to each other in order to completely disclose the invention.

As already indicated the invention has been embodied in a disclosure which is substantially like that of the above named patent to Raynsford. Both the present disclosure and that of the Raynsford patent show a skeletonized sender in which the numbers employed are for the most part the same as those in the more complete disclosure of U. S. Patent 1,589,402, granted to O. H. Kopp, June 22, 1926, and reference to the Kopp patent is made for operations not completely described herein.

As in the case of the above mentioned patents, a plurality of link circuits are arranged to serve two minor groups of calling lines and are taken into service in rotation. When a link circuit completes its function, it hunts for and associates itself with a district selector which is ready for use and the link and district remain in a sub-allotted condition until the next link in the series has been put into service. The link circuit is then put into an allotted condition from which it will be advanced by the initiation of a call and the action of the start circuit of Fig. 2. The trip circuit of Fig. 1 and start circuit of Fig. 2 are so arranged that only one line may be served at a time so that there may be cooperation between two groups of lines to both of which a group of link circuits is individual. The details of these functions do not form a part of this invention, are described in patent to William H. Matthies 1,567,072, granted December 29, 1925 and hence are omitted from the following description.

It is assumed that the subscriber at substation

100 is one belonging to subgroup A of the two minor subgroups A and B of subscribers and to class of service subgroup (a) and that the link circuit of Fig. 4, common to both classes of service subgroups, is arranged to indicate this fact to the sender in the manner to be described hereinafter. When, therefore, the subscriber at substation 100 removes his receiver from the switch-hook, a circuit is closed from battery through the winding of line relay 101, inner back contact of relay 102, over the subscriber's line, to ground at the outer contact of relay 102. Relay 101, in operating, closes a circuit from battery through resistance 104, winding of relay 103, to ground at the outer front contact of relay 101. Relay 103 is the identifying relay for minor group A of the two minor groups of lines A and B which are controlled by the trip circuit disclosed in Fig. 1; relay 106 being the identifying relay for minor group B and operates when a line from this latter group initiates a call. As more particularly described in the above mentioned patent to Matthies, there is a pair of relays like relays 103 and 106 to each trip circuit on the line-finder frame, there being as many such pairs as there are trip circuits or ten pairs. Relay 101 also prepares a circuit from battery through resistance 111 and the right winding of relay 109 in parallel, inner front contact of relay 101 to conductor 114 to identify the calling line to the line finder. Relay 103, in operating closes a circuit from battery over the back contact of relay 201, conductor 130, right winding of relay 108, inner back contact of relay 107, inner right contact of relay 103, to ground at the left contact of relay 109.

Relay 108 operates in this circuit and closes a locking circuit for itself from battery through the right winding of relay 201, conductor 129, over back contacts of relays similar to relay 108 individual to other groups of lines appearing before the same line finder, inner left front contact and left winding of relay 108, to ground at the right back contact of relay 109. Relay 108 closes a circuit from ground at its outer right front contact through the winding of trip magnet 303 of the line finder to battery in preparation for tripping the proper set of brushes when the line finder is operated. Relay 201 operates in the locking circuit of relay 108 and, in combination therewith, closes a circuit from ground over its outer right contact, conductor 128, inner right contact of relay 108, winding of relay 110 to battery. Relay 110 locks over its left contact to ground at the left back contact of relay 109, and partly prepares a circuit extending from ground, left outer contact of relay 108, left inner contact of relay 103 to conductor 131. Now conductor 131 terminates in terminal block 118 and conductor 150, which is the conductor connected to relay 106 corresponding to conductor 131 for minor group B, likewise terminates in terminal block 118 but in a separate terminal thereof. Each conductor 131 from each minor group relay 103 is wired to a separate terminal on terminal block 118 and likewise each conductor 150 from each minor group relay 106 is wired to a separate terminal on terminal block 118. Now cross-connecting terminal block 119 has connected to it four conductors, namely, conductors 134, 137, 136 and 135 which extend into the common start circuit and control, in the manner described hereinafter, the two separate classes of services (a) and (b) to which the lines associated with the line-finder frame are entitled. If the subscribers in subgroup A of Fig. 1 are in class of service

subgroup (a) and are entitled to one class of service, conductor 131 is cross-connected, say, to conductor 137 and if they are in class of service subgroup (b) and are entitled to the other, then conductor 131 is cross-connected to conductor 134. Similarly if subscribers in subgroup B of Fig. 1 are in class of service subgroup (a) and are entitled to the same class of service as the subscribers in the subgroup A whose conductor 131 is cross-connected to conductor 137, then conductor 150 is cross-connected to conductor 136 and if they are in class of service subgroup (b) and entitled to the same class of service as the subscribers in subgroup A whose conductor 131 is cross-connected to conductor 134, then conductor 150 is cross-connected to conductor 135. In the same manner conductors 131 of other subgroups A of the line-finder frame are connected to either conductor 137 or 134 depending on which of the two classes of service said subgroups are entitled to and conductors 150 of other subgroups B are connected to either conductor 136 or 135 for the same identification of classes. For the purpose of simplifying the description of the manner in which our invention operates, it will be assumed that subscribers in subgroup A of Fig. 1 are entitled to that class of service which is controlled over conductor 137 and that those in subgroup B are entitled to the other class of service which, for subgroup B, is controlled over conductor 135. Therefore, when relay 110 operates and extends ground to conductor 131 as above described, the circuit is further completed over conductor 137, bottom winding of relay 261, to battery. Relay 261 operates and over its bottom inner contact extends the circuit through the back contacts of relay 202, winding of relay 262, left winding of relay 203, to battery on the back contacts of relay 205. Relay 203 being marginal does not operate in this circuit, but relay 262 operates, locks and extends the locking ground to the right winding of relay 261, thereby locking this relay also. The circuit is now prepared for starting the allotted line finder. Assuming that the link and line finder shown are the ones to be used next, sequence switch 400 will be standing in position 1 and sequence switch 300 in position 2. The operation of relay 262 will, therefore, close a circuit from ground at its contacts, inner left back contact of relay 203, conductor 206, upper left and lower right contacts of cam 403, brush 402 and terminal 401, conductor 373, upper right and lower left contacts of cam 301, winding of relay 302 to battery.

Relay 302, in operating, closes a circuit from battery through the winding of up-drive magnet 304 of the line finder, right front contact of relay 302, lower right contact of cam 364, outer left front contact of relay 302, to ground at the lower left contact of cam 336. The line finder moves upward under the control of magnet 304, and since trip magnet 303 is operated, the proper set of brushes is tripped. As soon as the line finder moves upward, a locking circuit is provided for relay 302 extending over its inner left front contact, upper contacts of cam 308, right back contact of relay 320, commutator strip 321, brush 322 to ground, which holds relay 302 operated independent of the trip circuit.

In the meanwhile, at the time relay 302 operated, another circuit was closed extending from battery on the left inner back contacts of relay 205, right winding of relay 203, conductor 207, top contacts of jack 431, top winding of marginal relay 480, left lower and right upper contacts

of cam 405, brush 406 and terminal 407, conductor 379, right lower contact of cam 311, left outer front contact of relay 302, left lower contact of cam 336, to ground. Relay 203 operates in this circuit but relay 480, being marginal, does or does not operate depending on whether relay 261 has or has not been operated. Since it has been assumed that the calling line grounded conductor 137 and relay 261 operated thereby, the operation of this relay connects battery on the left inner contacts of relay 205 through low resistance 263 and bottom outer contacts of relay 261 to conductor 207 thereby placing resistance 263 in parallel with the right winding of relay 203 in circuit with the top winding of relay 480 as above described. This parallel combination reduces the effective resistance in series with the winding of relay 480 and the current flowing through relay 480 is sufficient to permit its operation. Relay 480 locks over its lower winding and top contacts to ground through the left lower contact of cam 482 to perform functions hereinafter described.

Relay 203, over its left inner front contact, short-circuits relay 262 causing it to release which in turn opens the locking circuit of relay 261, but relay 261 still remains operated over its initial operating circuit. Relay 203 further opens conductor 206 and locks over its inner left front contact, left back contacts of relay 202, bottom inner contacts of relay 261 to ground over conductors 137 and 131 as above traced. The remaining operations of the common start circuit shown in Fig. 2 are now the same as those described in the aforementioned patent to Matthies and will be referred to hereinafter only in connection with interrelated operations of the district selector shown in Fig. 3.

If the A subgroup of subscribers in Fig. 1 are entitled to the other class of service than the one assumed, then conductor 131 would not be cross-connected to conductor 137 but to conductor 134. Under such circumstances, when relay 103 operates, the ground on conductor 131 is not extended to the bottom winding of relay 261 as above described but is extended over conductor 134, back contacts of relay 202, the winding of relay 262 and left winding of relay 203 to battery on the back contact of relay 205, and also in parallel over the back contacts of relay 202, left inner back contact of relay 203, conductor 206 and thence over a previously traced circuit for operating relay 302. When, therefore, conductor 131 is cross-connected to conductor 134 instead of conductor 137 the circuit path to the winding of relay 261 is opened and this relay remains normal. The operating circuits for relays 203 and 480 are now the same as above described except that relay 261, being normal, battery through resistance 263 is not connected to conductor 207 in which event the quantity of current flowing through the top winding of relay 480 is not sufficient to operate relay 480 although relay 203 operates as before.

The discriminating signal for the one or the other class of service to which any subgroup A of the line-finder frame is entitled is controlled, then, by cross-connecting conductor 131 of the corresponding trip circuit either to conductor 137 or to conductor 134. The former cross-connection results in the operation of relay 261 and the consequent operation of discriminating relay 480 in the link while the latter cross-connection causes relay 261 to remain normal, in turn, preventing the operation of relay 480.

If a subscriber from subgroup B in Fig. 1 initiates a call, then relay 106 of the group circuit operates. If, now the subscribers in this subgroup are entitled to the class of service which is signalized by the operation of the class of service discriminating relay 480 of the connecting link, then conductor 150, which corresponds to conductor 131 in subgroup A, is cross-connected to conductor 136 at terminal block 119. The ground which is connected to conductor 150 by the operation of relay 110 as above described is extended, in this case, over conductor 136, top winding of relay 261 to battery. Relay 261 operates and, over its top inner contacts, extends the operating ground on conductor 136 through the back contacts of relay 265, winding of relay 266, right winding of relay 267, to battery on the back contacts of relay 268. Relay 266 operates in this circuit but relay 267, which is the relay for subgroups B corresponding to relay 203 of subgroups A, being marginal, does not. Relay 266 now locks through its contacts and extends ground over the right inner back contacts of relay 267 to a conductor 269 which corresponds to conductor 206 for operating the relay 302 of a district selector. Conductor 206 connects with the subdivision of the entire group of links which has first access to line subgroups B. This arrangement of subdividing a group of links into two smaller groups to insure even distribution of operation among the individual links comprising an entire group is so well known to the telephone art that it is not thought necessary to describe it any further.

Relay 261, in operating, connects battery on the left inner back contact of relay 268, through resistance 264 and top outer contacts of relay 261 to conductor 270 which corresponds to conductor 207. When, therefore, the circuit is closed through relay 480 and the left winding of relay 267 from the ground in the allotted district selector, marginal relay 480 will operate because of the parallel connection of resistance 264 to conductor 270 which places this resistance in parallel to the left winding of relay 267. The operation of relay 480 indicates the class of service to which subgroup B in which is located the calling line, is entitled.

Should the subgroup B be entitled to the class of service signalized by the normal condition of the service discriminating relay 480, then conductor 150 is not cross-connected to conductor 136 but to conductor 135. Under such circumstances, ground on conductor 150 is extended to conductor 135, right back contacts of relay 265, winding of relay 266, right winding of relay 267 to battery on the left outer back contact of relay 268 and in parallel therewith, right inner back contact of relay 267, conductor 269 and thence as indicated to the winding of relay 302 of the allotted district selector. Relay 261, in this case, is not operated. When, however, the circuit for relays 480 and 267 is closed through conductor 270 as above described, the fact that relay 261 is normal causes resistance 264 to be disconnected from conductor 270. The parallel circuit to relay 480 is thus opened and relay 480 does not operate, thereby indicating that the calling subgroup B is entitled to the second class of service.

It is believed that our general method of designating the different classes of service in each link of a common group of links has been sufficiently described to disclose the fundamental principle of which the above concrete example is but an embodiment. It is evident without any further elaboration or concrete illustrations that where

the number of classes of service is greater than two, other discriminating responsive apparatus may be connected in series with conductors 207 and 270 and controlled by appropriate battery potentials on conductors 131 and 150, respectively. It is easy to see that with a serial combination of polarized, marginal and sensitive relays controllable over conductors 207 and 270, respectively, as many classes of service may be indicated in a common group of links as is commercially desirable.

Referring now to the further detailed operation of our circuit arrangement, as soon as commutator brush 307 engages segment 305, a circuit is closed from ground over brush 307 and segment 305, lower right and upper left contacts of cam 306, conductor 404, contact 230 of key 204, inner right front contact of relay 201 to conductor 129 and the right winding of relay 201. This circuit shunts the winding of relay 108 and causes that relay to release, in turn releasing the trip magnet 303 and opening the circuit of relay 261 which now releases. When brush 307 leaves segment 305, the circuit of relay 201 is opened and that relay also releases, freeing the start circuit. When line-finder brush 381 makes contact with terminal 380 which is connected to conductor 114 and therefore to battery, a circuit is completed from this battery through the winding of relay 320, lower left and upper right contacts of cam 341, to ground at the lower right contact of cam 339. Relay 320 operates in this circuit and closes a shunt around its winding through resistance 319, to ground over commutator strip 321 and brush 322. This reduces the resistance in series with the winding of marginal relay 109 sufficiently to cause that relay to operate and open the locking circuit of relay 110, which in turn opens the energizing circuit of relay 302, and the locking circuit of relay 203. The operation of relay 320 also opens the locking circuit of relay 302, causing that relay to release. The release of relay 302 closes a circuit from ground through the winding of cut-off relay 102, conductor 112, terminal 327, brush 326, inner left back contact of relay 317, right back contact of relay 302, lower left contact of cam 324, resistance 323 to battery. The operation of cut-off relay 102 opens the circuit of line relay 101, removing battery from conductor 114, releasing relays 109 and 320.

At the time relay 302 operated to close the circuit of relay 203 as above described, it further extended the ground on brush 406 over the bottom contacts of jack 481, right lower contact of cam 408, winding of relay 409, resistance 411 to battery. Relay 409 operates and closes a circuit from battery through the winding of sequence switch magnet 400, upper contact of cam 412, to ground at the outer left contact of relay 409, advancing the link sequence switch 400 to position 2. When sequence switch 400 leaves position 1, relay 409 is released. In position 2, a circuit is closed from battery through the winding of relay 413, upper contacts of cam 414, right back contact of relay 415, to ground at the lower right contact of cam 416. Relay 413 operates, closing a circuit from battery through the left winding of relay 417, left front contact of relay 413, to ground at the left back contact of relay 415. Relay 417, in operating, closes a circuit from battery through the winding of up-drive magnet 418 of the sender finder 420, left contact of cam 479, outer right contact of relay 417, to ground at the left back contact of relay

409. The sender finder moves upward under 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, upper contacts of cam 421, middle winding of relay 415, to ground at the right contact of relay 413. The current in this circuit, however, is not sufficient to operate relay 415 but does create a flux in the windings of that relay so that it becomes quick to operate when the test circuit is closed. The test circuit extends from brush 422 over the lower contacts of cam 419, right back contact of relay 409, left winding of relay 415, lower right and upper left contacts of cam 421, middle winding of relay 415, to ground at the right contact of relay 413. An idle sender is characterized by battery connected to conductor 502. When, therefore, brush 422 engages terminal 423, corresponding to the sender of Fig. 5 which is assumed to be idle, the test circuit above traced is completed over terminal 423 to battery and relay 415 operates quickly. The relay 415 in operating closes a locking circuit for itself from battery through its right winding, upper contacts of cam 421, to ground at the left front contact of relay 415. It also opens the circuit of relay 417 which releases, to in turn release magnet 418 and bring the sender finder to rest on the terminals of the idle sender. The release of relay 417 in turn releases relay 413. With relay 413 released and relay 415 operated, a circuit is closed from battery through the winding of sequence switch magnet 400, lower left contact of cam 476, contact 427 of jack 428, left back contact of relay 413, right front contact of relay 415, to ground at the lower right contact of cam 416, advancing sequence switch 400 to position 3.

When sequence switch 400 reaches position $2\frac{3}{4}$ a circuit is closed for informing the sender of the class of service to which the calling line is entitled. If relay 480 is operated to indicate one class of service the circuit may be traced from ground on the lower front contact of relay 480, upper left and lower right contacts of cam 405, brush 438, terminal 439, conductor 692, outer right contact of relay 510, winding of relay 691 to battery. If relay 480 has not been operated and therefore indicates the other and second class of service then the circuit extends from ground over the lower back contact of relay 480, the left contacts of cam 435, brush 436, terminal 437, right back contact of relay 621, conductor 693, normal contacts and winding of relay 690 to battery. Either 691 or 690 operates in these circuits. These relays then prepare circuits which are effective if the subscriber dials the code appropriate to each of these classes of service.

It is evident that these circuit combinations for operating relay 691 or 690 depending on the condition of relay 480 are purely illustrative. Where the register sender is arranged so that both relays must be operated or both released depending on the signal received from the link, the operating circuits for both of these relays may be controlled over separate groups of contacts on a relay 480 supplied with such contacts. The essence of our invention is devices in a common link responsive to calling lines in arranged groups for different classes of service and to which said link has common access and the further control of responsive devices in the register sender from said responsive devices in the link; the specific circuit arrangement between the link and the sender being in each case adapted to the character

of the link and the character of the sender.

When sequence switch 400 reaches position 3, a circuit is closed from ground through the left and middle windings of relay 503, left back contacts of relays 504 and 505, conductor 506, terminal 430, brush 431, right contact of cam 434, brush 432 and terminal 433, conductor 315, lower contacts of cam 316 (assuming that the district selector has been advanced to position 3 as above described), through the left winding of relay 317 to battery, and in parallel therewith over the upper left contact of cam 316, through the winding of relay 351 to battery. Relay 317 is marginal and does not operate; relay 351 operates but is ineffective at this time. Relay 503 also operates and closes an obvious circuit for relay 507 which in turn closes a circuit for relay 509. Relay 509 closes a circuit for relay 510. With relays 507 and 509 operated, locking ground is provided over the contact of cam 514 to relays 690 and 691. Relay 510, in operating, opens the energizing circuit of relay 691, and relay 690 opens its own energizing circuit so that the discriminating condition exists only temporarily.

As soon as sequence switch 400 arrives in position $2\frac{3}{4}$, it prepared the pulsing circuit for receiving dial pulses. This circuit may be traced from battery through the left winding of relay 606, conductor 637, terminal 440, brush 441, lower contact of cam 429, brush 478, terminal 477, conductor 375, left contact of cam 335, outer left back contact of relay 317, brush 334, terminal 333, conductor 117, through the subscriber's substation, conductor 116, terminal 332, brush 331, right back contact of relay 317, winding of relay 330, left contact of cam 329, conductor 382, terminal 442, brush 443, upper right and lower left contacts of cam 403, brush 444 and terminal 445, to ground at the back contact of relay 513. Relay 606 operates, in turn operating relay 610 in the well known manner, relay 610 operating relay 609. A circuit is thereupon closed from the source of tone 607 through the right winding of relay 606, timing switch 804 in its normal position, front contact of relay 609, contact of cam 514, to ground at the front contact of relay 509. This tone is transmitted to the calling subscriber to inform him that the sender is ready to receive impulses which he may then send out by manipulating his dial.

When relay 510 operated, it removed battery from conductor 502, releasing relay 415. With relay 415 released, a circuit is closed from battery through the winding of sequence switch magnet 400, upper left contact of cam 476, right back contact of relay 415, to ground at the lower right contact of cam 416. Sequence switch 400 advances to position 5 over this circuit and remains in this position throughout the further operation of the sender.

Assuming that the calling subscriber registers a number in an office to which he is allowed to have access, for which character of service, it is assumed, relays 690 and 691 are ineffective then the call will be completed in the manner described in the above identified patent to O. H. Kopp. When the connection has been set up to the called subscriber's lines, reverse battery from the incoming selector operates relays 702 and 704 in the usual manner. These relays in turn cause the operation of relay 708 and relays 524 and 504. With these relays operated, the sender is then advanced to position for making talking selection. The district selector sequence switch is advanced to position 10 in the manner described in the

above identified patent. Relay 351 is operated in parallel with the winding of relay 317 through-out selections. The operation of relay 504, above mentioned, opens a shunt around the right winding of relay 503 including that winding in the circuit of relays 351 and 317. Relay 351 thereupon releases, advancing the district selector to position 11 in which position ground is connected over the upper right contact of cam 336 to conductor 315, which is extended over terminal 433, brush 432, upper contacts of cam 446, left winding of relay 415, right back contact of relay 409, left contact of cam 343, brush 431, terminal 430, conductor 506, left back contact of relay 505 to the windings of relays 503. Since these 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 this relay is locked to its own front contact. A circuit is therefore closed from ground over the back contact of relay 507, left front contact of relay 509, to the winding of relay 505 which locks over its middle left front contact to conductor 506 and to ground as above traced.

After talking selections are completed, relay 515 operates, connecting battery to conductor 506 in parallel with the winding of relay 505. The current in this circuit is now sufficient to operate relay 415 which closes a circuit from battery through the left winding of relay 417, left contacts of cam 421, to ground at the left front contact of relay 415. Relay 417 closes a circuit from battery through the winding of sequence switch magnet 400, upper contact of cam 479, outer right front contact of relay 417, left back contact of relay 409 to ground, advancing sequence switch 400 to position 6. In this position, all of the conductors extending to the sender are opened and the sender is completely released. As soon as sequence switch 400 leaves position 5, relay 415 releases and in turn releases relay 417 unless the sender finder 420 is standing on one of its top ten terminals. If the latter is true, relay 417 is held operated in a circuit from battery over its left winding, left front contact, upper left contact of cam 424, commutator segment 464, brush 463 to ground. With relay 417 held operated at this time, a circuit is closed from battery through resistance 411, winding of relay 409, lower contacts of cam 414, inner right front contact of relay 417, lower right contact of cam 416 to ground. Relay 409 locks through its inner left contacts to ground at the lower contact of cam 467 and also closes a second locking circuit for relay 417. With relay 409 operated, a circuit is closed from battery through the winding of down-drive magnet 465 of the sender finder 420, left contact of cam 412, to ground at the outer left front contact of relay 409. When the sender finder reaches its lowermost position, a circuit is closed from ground over brush 463, bottom commutator segment 406, upper contact of cam 456 to resistance 411, shunting the winding of relay 409 and causing that relay to release and in turn release relay 417. With relay 417 released in position 6, a circuit is closed from battery through the winding of sequence switch magnet 400, lower right contact of cam 476, right back contact of relay 417 to ground at the lower right contact of cam 416, advancing sequence switch 400 to position 7. When switch 400 leaves position 6½ relay 480 is unlocked at the left lower contact of cam 482 permitting this relay to release.

When sequence switch 400 reaches position 7,

the link circuit is ready to associate itself with another district selector. If another district selector is standing in position 1 waiting association with a link, a circuit will be closed from ground over the lower left contact of cam 339 of that district, contact 393 of jack 374, conductor 392, contacts of jack 448, contacts of jack 449, upper contact of cam 416, right back contact of relay 415, upper contacts of cam 414, winding of relay 413 to battery. Relay 413 closes a circuit from battery through the left winding of relay 417, left front contact of relay 413, to ground at the left back contact of relay 415. Relay 417, in operating, closes a circuit for up-drive magnet 447 of the district finder 410, lower right contact of cam 479, outer right front contact of relay 417, left back contact of relay 409, to ground. The district finder moves upward under control of magnet 447 in search of the district which is awaiting a link. Such a district is identified by battery connected over the left contacts of cam 344 of that district, contacts 373 of jack 374, to conductor 366. Relay 413, in operating, closes the same circuit through the right and middle windings of relay 415 as it closed in position 2. At this time the test circuit extends from ground at the right front contact of relay 413, through the middle winding of relay 415, upper left and lower right contacts of cam 421, left winding of relay 415, right back contact of relay 409, lower right and upper left contacts of cam 419, contacts of jack 449 to brush 451.

If the district selector for which the district finder is hunting does not lie between the last position occupied by the finder and the top of its bank, it will continue to move upward until brush 453 engages segment 452, completing a circuit over the upper right contact of cam 408, winding of relay 409, resistance 411 to battery. The operation of relay 409 opens the test circuit, opens the circuit of up-drive magnet 447 and closes a circuit from battery through the winding of down-drive magnet 454, lower right contact of cam 412, outer left front contact of relay 409 to ground. The district finder is restored to its lowermost position under the control of magnet 454, at which time a circuit is closed from ground over brush 453, bottom segment 455 of the district finder commutator, lower right contact of cam 456 to resistance 411, shunting and releasing relay 409 which restores the test circuit and the circuit of up-drive magnet 447. When brush 451 encounters terminal 450 to which conductor 336 extends, the test circuit is completed and relay 415 operates quickly as in the previous case. Relay 415 locks through its right winding, the upper contacts of cam 421, to ground at its left front contact, opening the circuit of relay 417 to release magnet 447 and bring the district finder to rest on the terminals of the district and releasing relay 413. With relay 415 operated and relay 413 released, a circuit is closed from battery through the winding of sequence switch magnet 400, lower left contact of cam 476, contacts 427 of jack 428, back contact of relay 413, right front contact of relay 415, upper right contact of cam 416, contacts of jacks 449 and 448 to conductor 392. Sequence switch 400 advances to position 8 in this circuit.

Relay 415 is held operated in position 8 from battery at the district over terminal 450, brush 451, contacts of jack 449, upper left and lower right contacts of cam 419, back contact of relay 409, left winding of relay 415, lower right and upper left contacts of cam 421, to ground at the

left front contact of relay 415. With relay 415 operated, a circuit is closed from ground at the lower right contact of cam 416, right front contact of relay 415, upper left contact of cam 429, brush 473, terminal 477, conductor 375, lower right contact of cam 312, lower right contact of cam 313, left winding of relay 314 to battery. Relay 314 closes a circuit from battery through the winding of sequence switch magnet 300, upper left contact of cam 328, right front contact of relay 314, left back contact of relay 302 to ground at the lower left contact of cam 336. Sequence switch 300 advances to position 2 in this circuit, releasing relay 314. The advance to position 2 removes ground from conductor 392 and battery from conductor 366. The removal of battery from conductor 366 opens the circuit of relay 415, and that relay releases, closing a circuit from battery through the winding of sequence switch magnet 400, upper left contact of cam 476, right back contact of relay 415, to ground at the lower right contact of cam 416. Sequence switch 400 advances to position 9.

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

Referring again to the registration of the classes of calling lines in the sender it must not be thought that the classes which may be so registered therein are necessarily restricted to those which will permit the sender to function for completing connections to called subscribers only where the class indicating devices are normal, as was the case in the illustration above described with relays 690 and 691. On the contrary, register senders are well recognized as flexible control circuits and may be easily rearranged to route a calling line in any manner indicated by the class indicating devices. The right contacts of relays 690 and 691 are not shown connected to any part of the translator 830, but the manner in which the sender disposes of the call is controlled by the translator to the arcs of which any controlling condition may be imposed, including the routing controlled by the operated condition of relays 690 and 691.

Inasmuch as the present invention is not concerned with the specific operation of the district selector of Fig. 3, or the operation of selectors to further extend the calling line and the functioning of the sender to control selections no detailed description thereof has been given herein. The selector circuits employed in the establishment of the talking connection are released following the termination of the conversation in the manner fully set forth in the patents hereinbefore referred to.

What is claimed is:

1. In a telephone system, calling lines arranged in groups according to the class of service to which they are entitled, a plurality of link circuits common to said groups, and means in each of said link circuits controllable through the initiation of a call by a line in any of said groups for register-

ing the class of service to which said line is entitled.

2. In a telephone system, calling lines arranged in groups according to the class of service to which they are entitled, a plurality of link circuits common to said groups, and marginal means in each of said link circuits controllable through the initiation of a call by a line in any of said groups for registering the class of service to which said line is entitled.

3. In a telephone system, a group of calling lines arranged in two subgroups according to the class of service to which they are entitled, a group of link circuits common to said subgroups, a marginal means in each of said link circuits controllable through the initiation of a call by a line in either subgroup for registering the class of service to which said line is entitled.

4. In a telephone system, calling lines arranged in groups according to the class of service to which they are entitled, a group of link circuits common to said groups, marginal means in each of said link circuits controllable through the initiation of a call by a line in any of said groups for registering the class of service to which said line is entitled, control devices capable of operable connection to said group of lines for controlling the automatic establishment of connections, said control devices being associated with said calling lines through the intermediation of said link circuits, means responsive to the initiation of a call by said calling line to cause one of said link circuits to associate a control device with said line, and variable means in said control device responsive to said marginal means in said link for setting up a registration in said control device of the class of service of said calling line.

5. In a telephone system, calling lines arranged in groups according to the class of service to which they are entitled, link circuits common to all groups, marginal means in each of said link circuits controllable through the initiation of a call by one of said lines for registering therein the class of service of said line, control devices common to said link circuits, said control devices being associated with calling lines through the intermediation of said link circuits, and means in said control devices responsive to said marginal means to record the class of said calling line.

6. In a telephone system, lines arranged in two groups according to the class of service to which they are entitled, a start circuit for said lines responsive to a calling line in each group, a group of link circuits common to both groups of lines, a marginal relay in each of said link circuits, and means in said start circuits responsive to a calling line from either group to control said marginal relay for indicating in said link the class of service of said calling line.

7. In a telephone system, a group of lines arranged in subgroups according to the class of service to which they are entitled, a group circuit for each of two subgroups responsive respectively to a calling line from either subgroup, a common start circuit responsive to any subgroup when operated by a calling line therein, a relay in said start circuit common to all group circuits and responsive to a calling line in any subgroup thereof entitled to the same class of service, a group of link circuits common to said group of lines and controllable over said start circuit, and a relay in each of said link circuits responsive to said relay in said start circuit for indicating in said link the class of service of said calling line.

8. In a telephone system, a group of lines ar-

ranged in a plurality of subgroups according to either of two classes of service to which said lines are entitled, a group circuit for each of two subgroups responsive respectively to a calling line from either associated subgroup, a common start circuit responsive to any group circuit, a relay in said start circuit arranged for connection to all subgroups entitled to the same class of service, means responsive to the operation of any of said group circuits by a calling line in an associated subgroup entitled to said class of service for operating said relay, a group of link circuits common to said lines and controllable over said start circuit, and a marginal relay in each of said link circuits controlled through said start circuit responsive to said relay in said start circuit for indicating in said link one class of service and unresponsive when said relay is unoperated for indicating in said link the other class of service.

9. In a telephone system, a group of lines arranged in two sets of subgroups, some of said lines being entitled to one class of service and other of said lines being entitled to another class of service, each of said subgroups containing only the lines entitled to the same class of service, a group circuit for each two of said subgroups responsive respectively to a calling line from either associated subgroup, a common start circuit responsive to any group circuit, a relay having two windings in said start circuit, one of said windings being arranged for connection to any subgroup of one set of said subgroups entitled to one of said classes of service, and the other of said windings being arranged for connection to any subgroup of the said other set of subgroups entitled to the same class of service, a first resistance, a second resistance, a group of link circuits common to said lines and controllable over said start circuit, a marginal relay in each of said link circuits controllable over said start circuit for indicating one class of service when operated and a second class of service when not operated, means responsive to a calling line in a subgroup connected to one of the windings of said relay in said start circuit for causing the allotment of one of said links to said line and the operation of said relay, means responsive to the operation of said relay for connecting said first resistance in parallel with said marginal relay for operating said relay to indicate the class of service of said calling line, means responsive to a calling line in a subgroup connected to the other winding of said relay in said start circuit for causing the allotment of one of said links to said line and the operation of said relay and means responsive to the operation of said relay for connecting said second resistance in parallel with said marginal relay for operating said marginal relay to indicate the same class of service.

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