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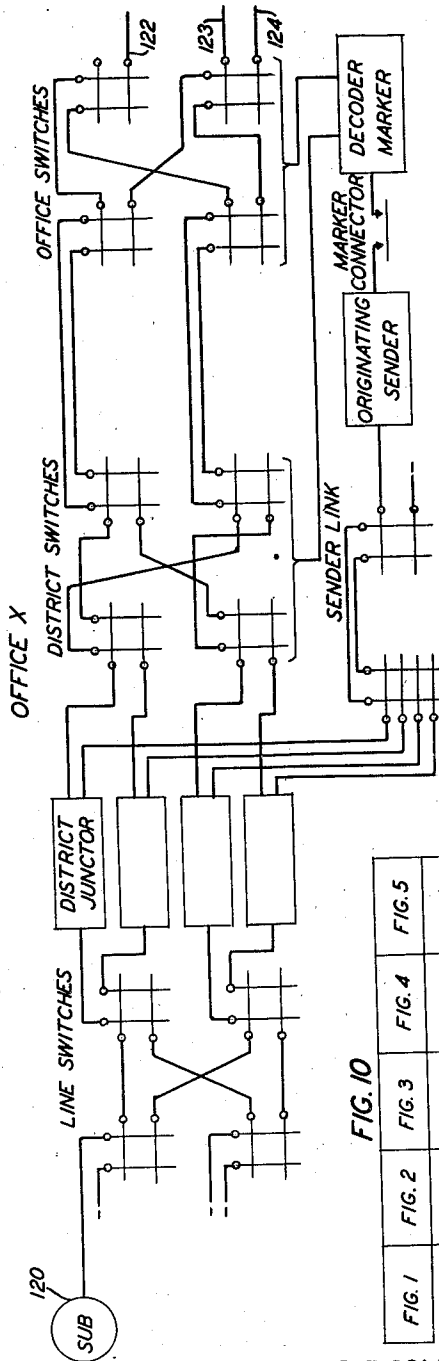
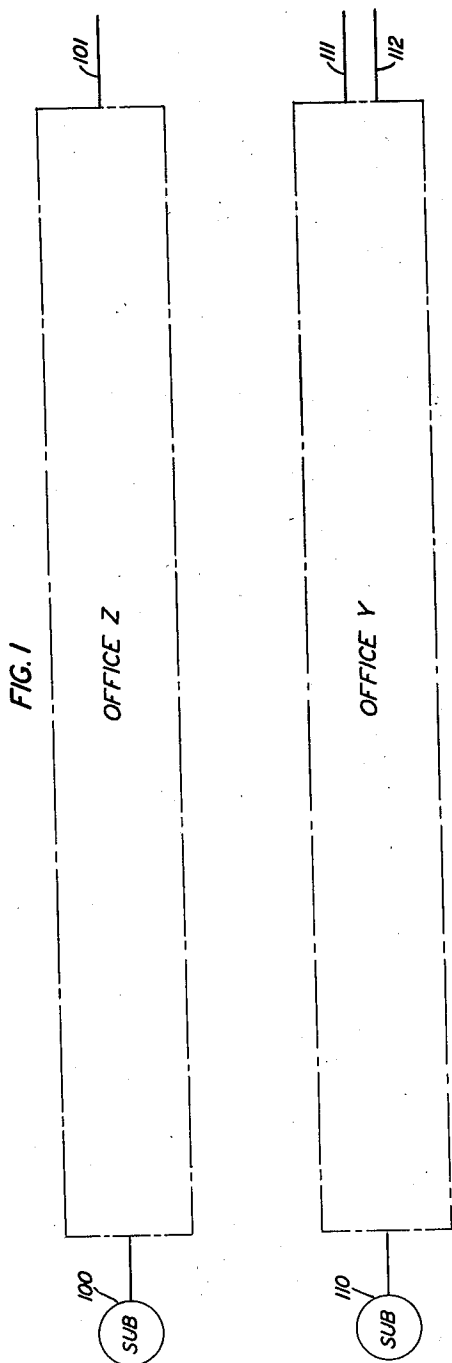
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2,299,212

TELEPHONE SYSTEM

Filed July 3, 1941

9 Sheets-Sheet 1



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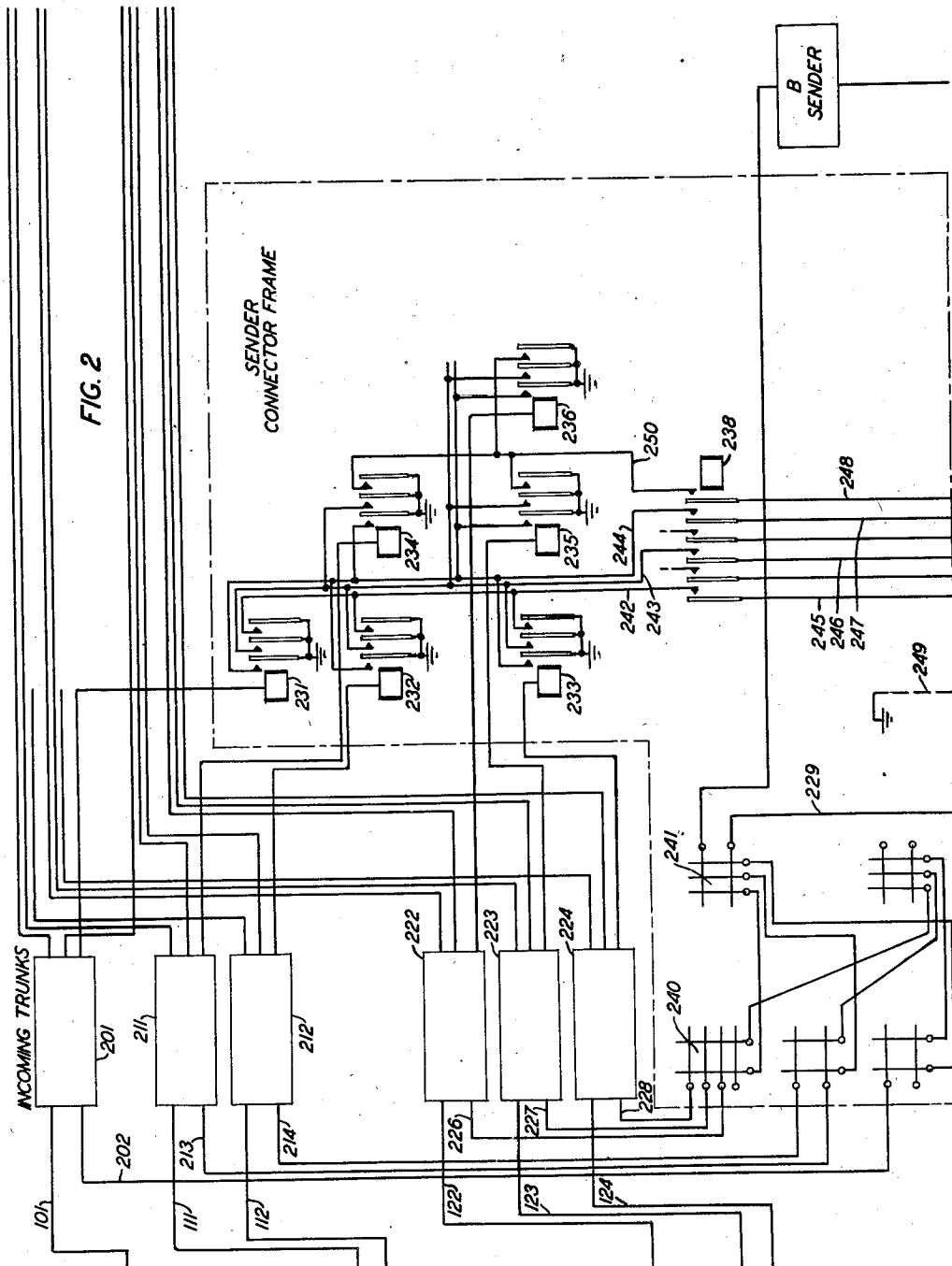
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TELEPHONE SYSTEM

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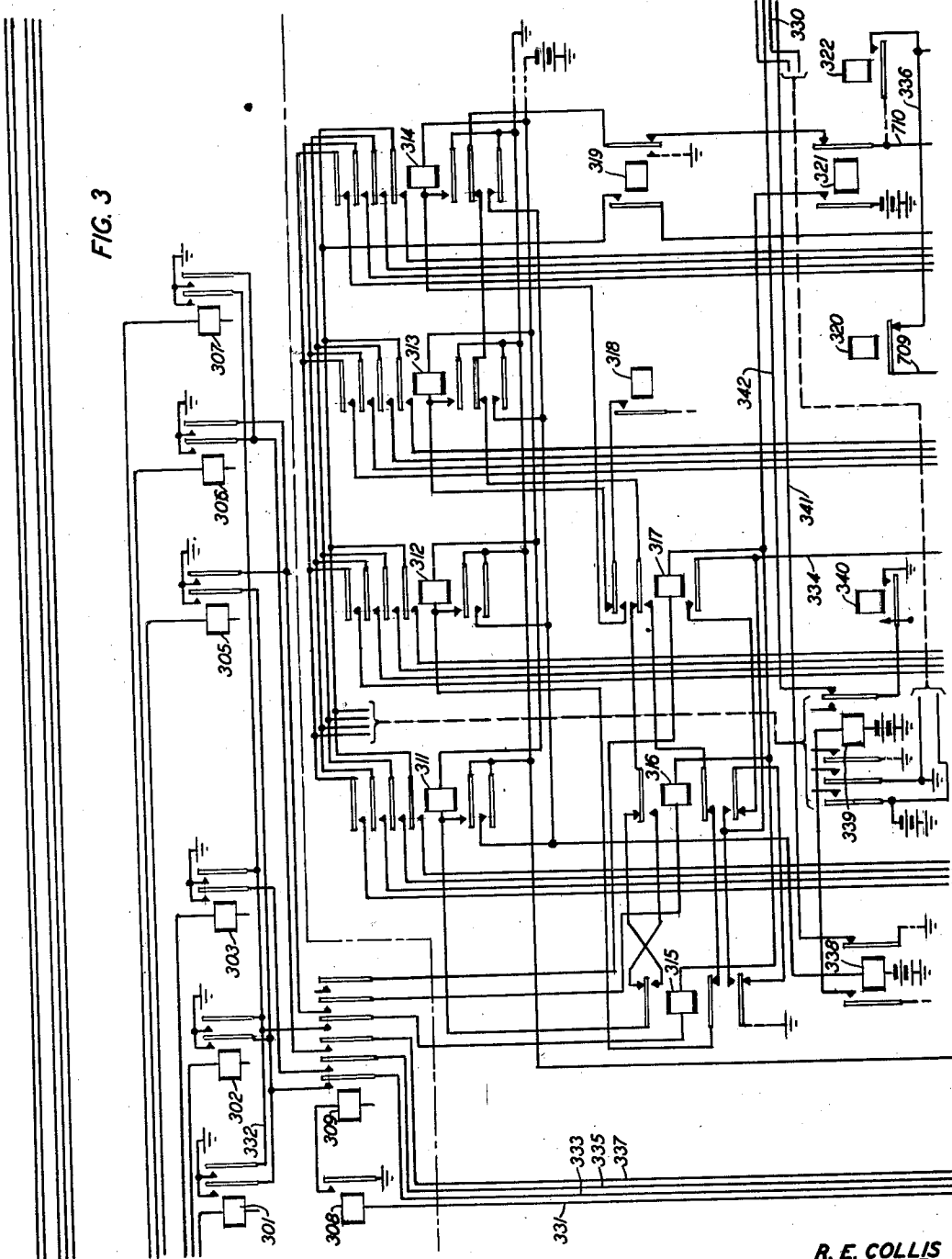
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FIG. 3



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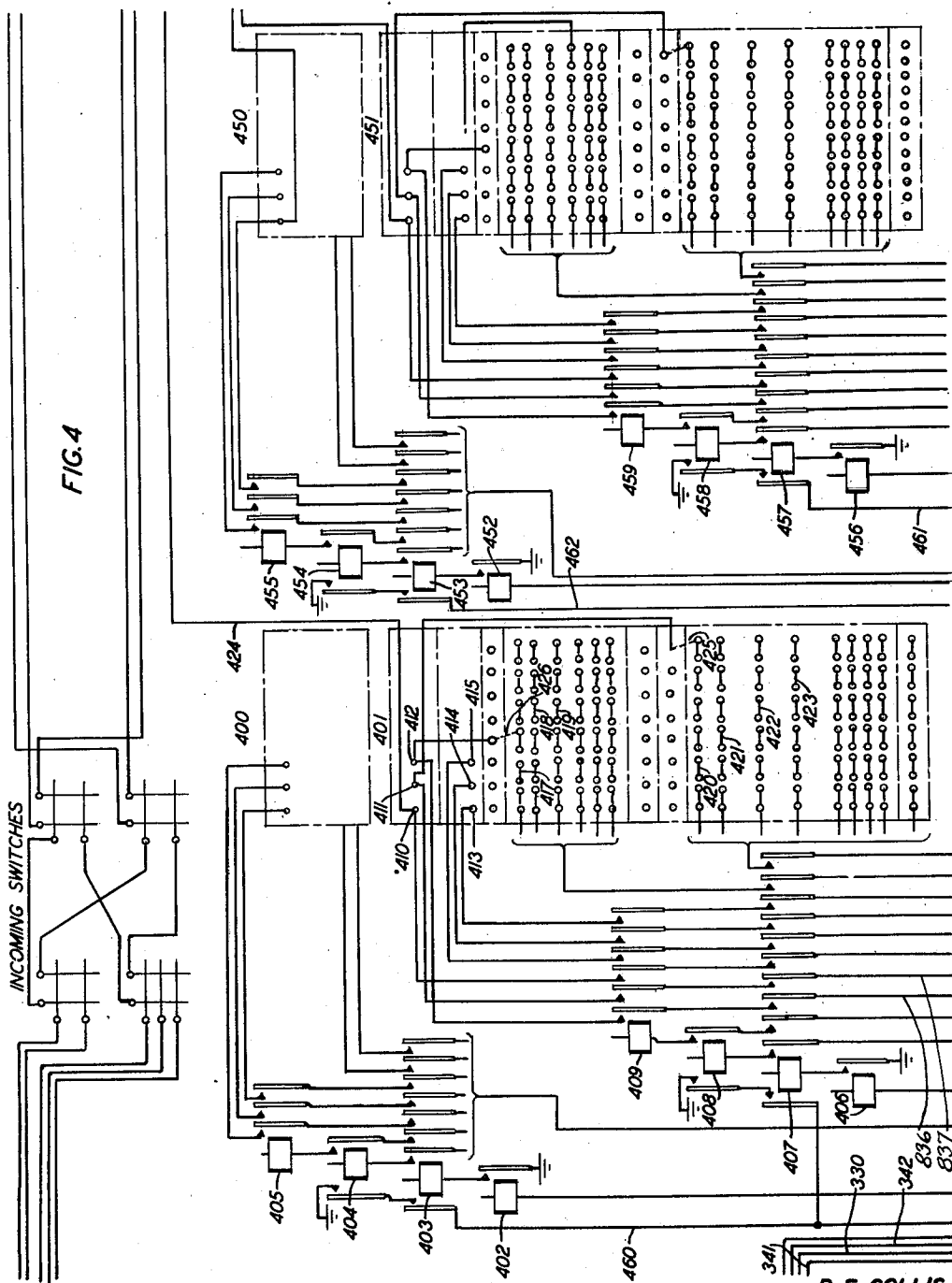
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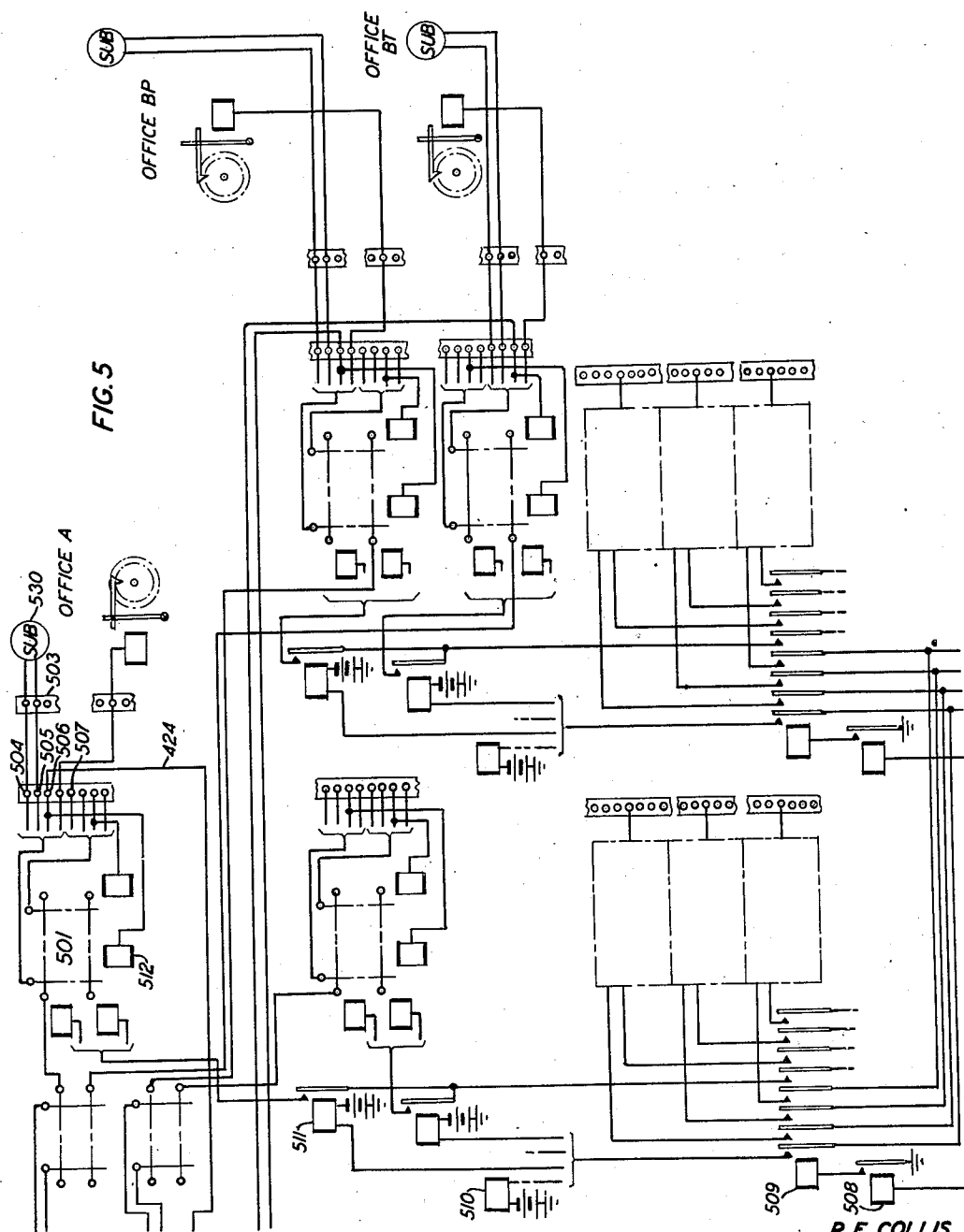
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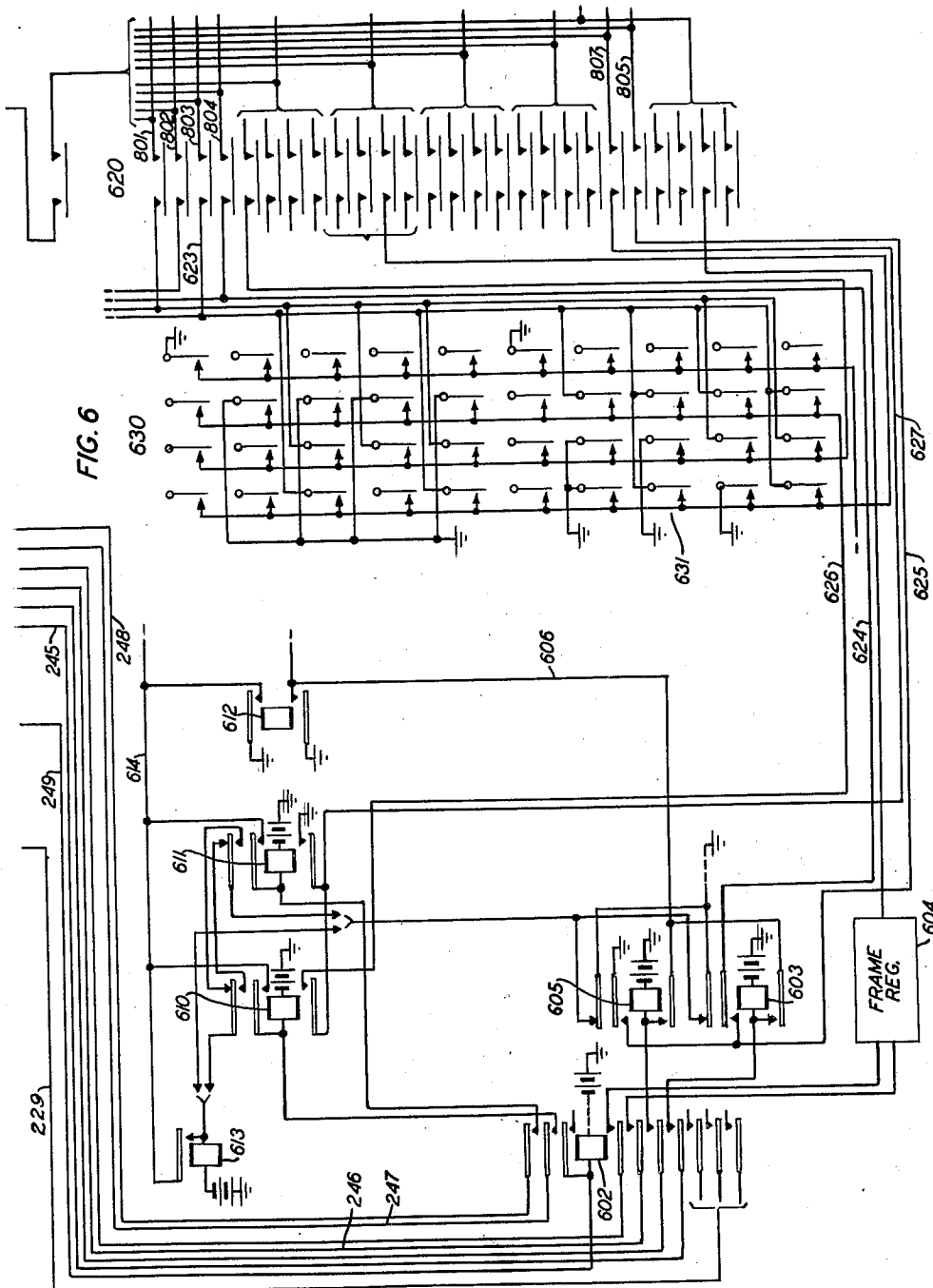
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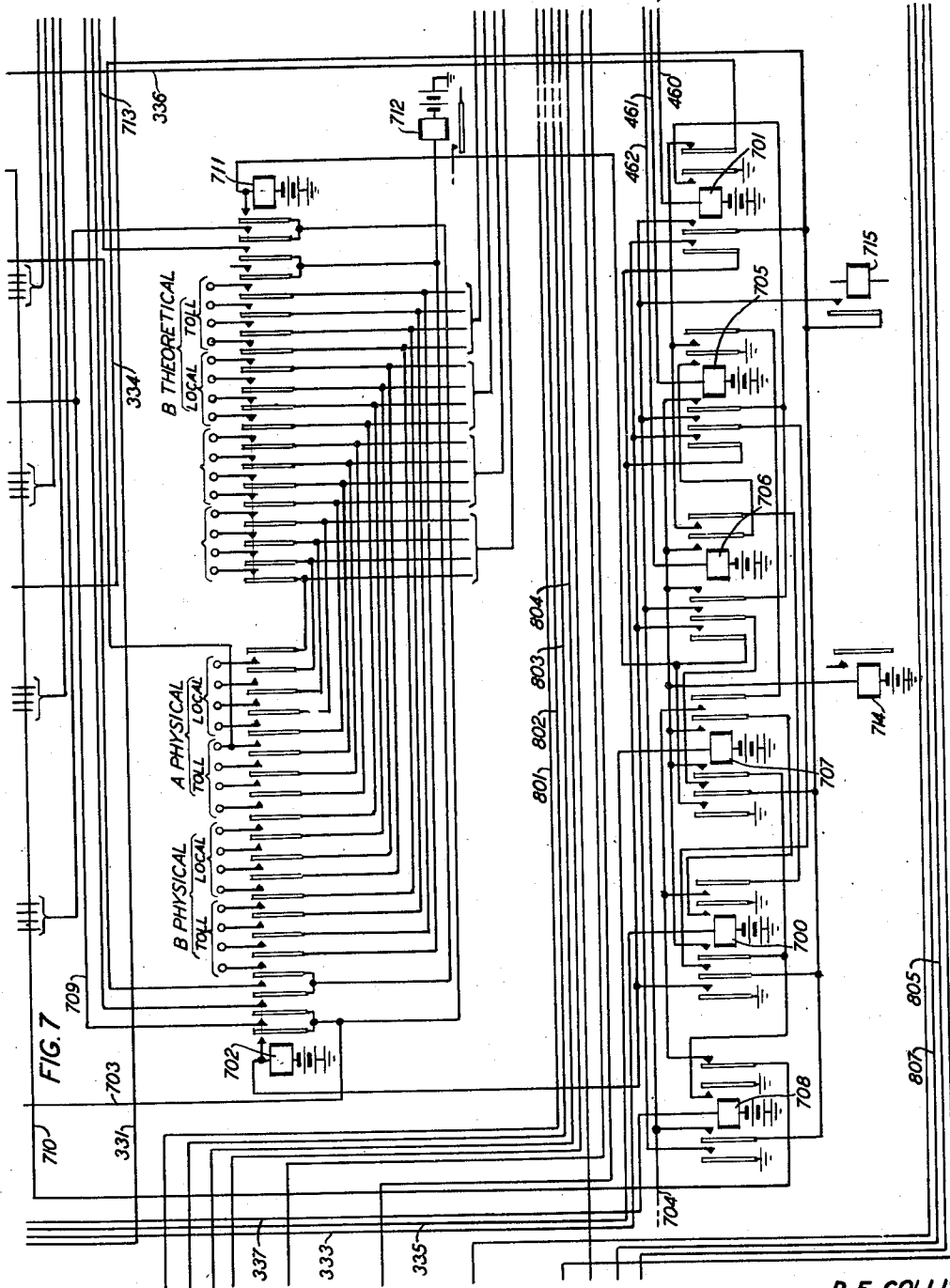
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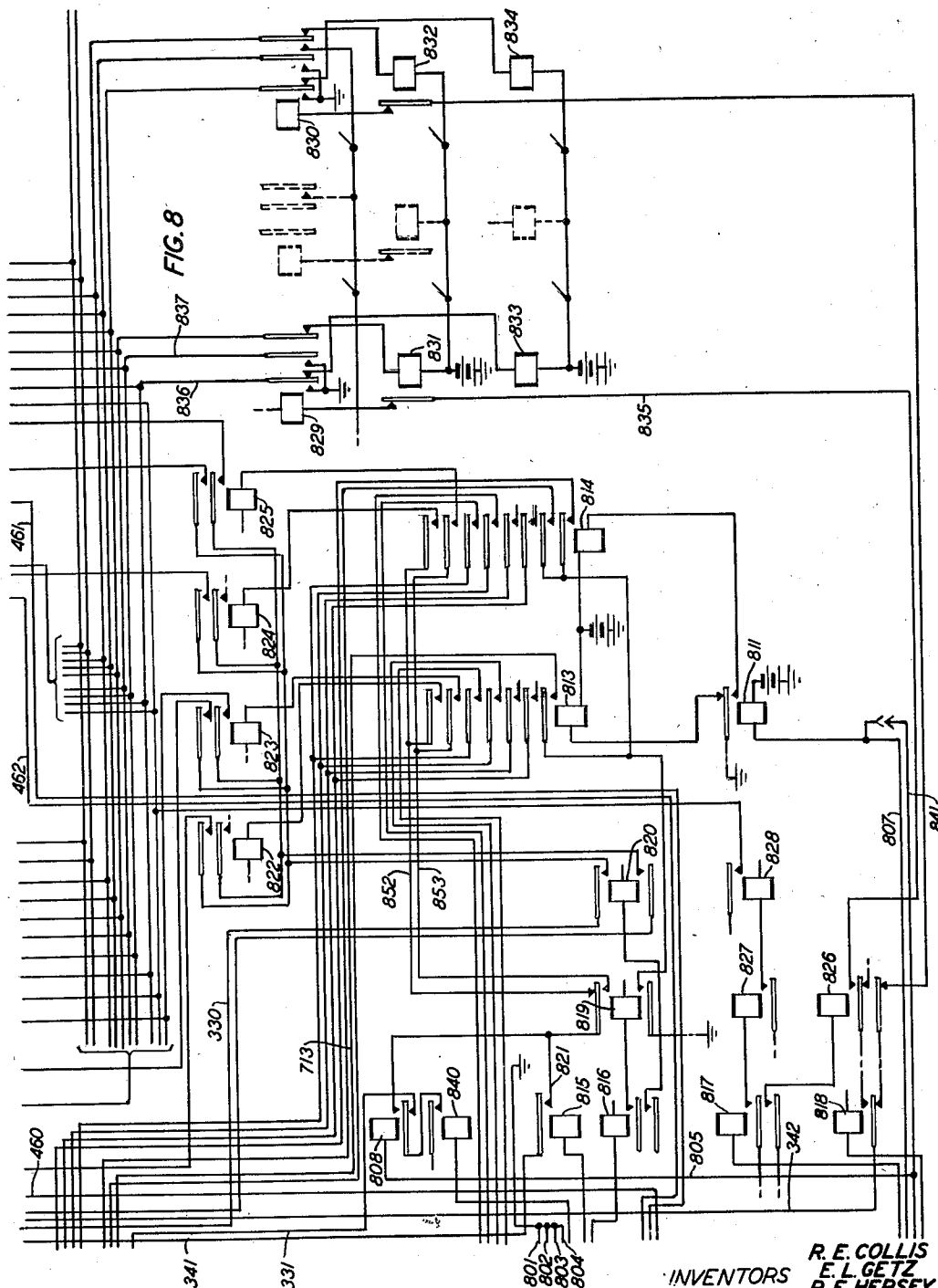
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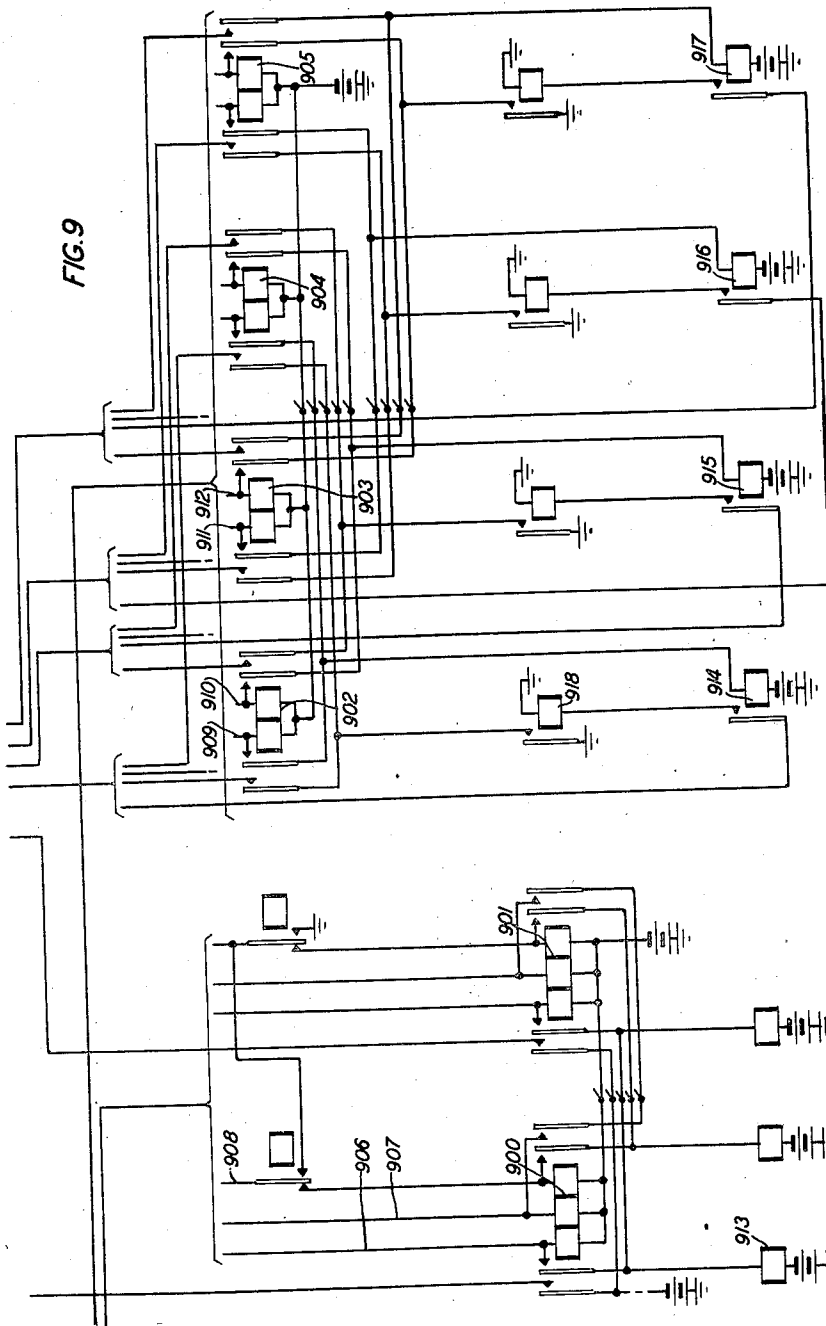
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UNITED STATES PATENT OFFICE

2,299,212

TELEPHONE SYSTEM

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Application July 3, 1941, Serial No. 400,892

11 Claims. (Cl. 179-27)

This invention relates to telephone systems and has for its object to facilitate the serving of special groups of subscribers.

In the crossbar system, conversational connections are established through crossbar switches under the control of common equipment such as senders and markers. A telephone office normally serves a maximum of ten thousand lines for which a predetermined number of switches are required, together with a certain amount of control equipment. Where the arrangement of the community permits, two offices may be located in the same building and it has been suggested heretofore that, in such a case, the control equipment may be arranged to serve both offices with an economy in the total amount of such equipment required.

On the other hand, there may be groups of subscribers which, although served from a particular office, are so located geographically in the area that they require a different charging rate than the other subscribers.

In accordance with the present invention, such subscribers are assigned to a definite group of numbers within the ten thousand lines of the office and in addition are given a distinctive office name; such offices being known as theoretical offices to distinguish them from the remaining numbers with their office name which constitute the physical office.

Where interoffice calls to such theoretical offices require an extra charge, individual trunk groups may be provided. In other cases the theoretical and physical offices may be reached over the same trunk groups.

In accordance with one feature of the present invention, means is provided in common control equipment for indicating whether an incoming trunk is one individual to the theoretical office and preventing the completion of the connection if the number of the wanted line is in the physical office and vice versa.

More specifically, registrations are set up in the common control equipment or marker indicative of the character of the incoming trunk and of the group of numbers including the wanted number. If these indications correspond, the call is completed, but if they do not agree, the call is routed to an intercept operator. These calls are extended over trunks which indicate to the operator whether or not the call reached the terminating office over a restricted trunk group.

In addition means is provided for restricting

certain types of ringing to one or the other office if desired.

For a more comprehensive understanding of the invention, reference may be had to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 shows schematically subscribers' lines terminating at three originating offices, together with the line link, district and office frames of crossbar switches, sender link, sender and marker at one office;

Figs. 2 to 9, inclusive, disclose such portions of the equipment of the terminating offices as are necessary to an understanding of the invention; Fig. 2 showing schematically a plurality of incoming trunk circuits, a terminating sender link and controller for associating any incoming trunk with an idle terminating sender, and relay equipment for transmitting to the terminating sender an identification of the group of incoming trunks seized for the completion of a connection; Fig. 3 showing the means for transmitting to the marker an indication of the nature of the incoming trunks; Fig. 4 showing an incoming link frame and two number group units; Fig. 5 showing a plurality of line link frames in each of two line choices and subscribers' lines terminating in three office units; Fig. 6 showing such portions of the terminating sender as are of particular interest in connection with the present invention and a marker connector by which an idle terminating marker is associated with the sender; Fig. 7 showing the marker equipment for checking the trunk class against the number group and Figs. 8 and 9 showing further marker relays and circuits; and

Fig. 10 is a chart indicating how the several figures of the drawings should be arranged to completely disclose the invention.

In the disclosure it has been assumed that the incoming links, line choice connectors, line links, senders and markers are common to two offices, A and B, one of which, namely office B, is further divided into a physical office BP and a theoretical office BT. In order to illustrate the operation of the circuits for a number of types of trunk groups, three originating offices X, Y and Z are indicated. Office X is represented as a full selector crossbar office and has groups of trunks individual to office A, office BP and office BT. Office Y is represented as a manual office and has a group of trunks individual to office A and a second group common to office BP and office BT. Office Z is represented as a full selector

crossbar office having one group of trunks common to all three terminating offices.

The present disclosure and description includes only as much of the crossbar system as is necessary for an understanding of the invention. For a complete disclosure of various parts of the terminating equipment and its operation reference is made to United States Patent 2,089,921 to W. W. Carpenter, August 10, 1937, United States Patent 2,232,371 to J. W. Dehn et al., February 18, 1941, and to United States Patent 2,261,370 to R. E. Hersey et al., November 4, 1941.

In general, the operation of the system is as follows: Upon the initiation of a call, for example on line 120, the line is extended by the primary and secondary line switches to an idle district junctor, and through the primary and secondary switches of the sender link to an idle originating sender. When the subscriber dials the wanted line designation, the digits of the designation are registered in the sender, an idle marker is attached to the sender by the marker connector and the office designation is transferred to the marker. The marker in turn connects, by means of a frame connector (not shown), to the district frame. It translates the office designation and operates a route relay. Under the control of this route relay, it connects with the office frame having access to an idle trunk extending to the wanted office, selects an idle channel between the district junctor and the idle trunk and releases. The functions above described take place substantially as described in United States Patent 2,235,803 to W. W. Carpenter, March 18, 1941.

According to the previous assumption, office X is connected with the terminating office building by three groups of trunks. One trunk in each group has been indicated, trunk 124 belonging to the group individual to office A, trunk 123 to the group individual to office BP and trunk 122 to the group individual to office BT.

Assume further that the wanted line is in office A, and that the call has been extended to trunk 124 which terminates in incoming trunk circuit 224. When the connection reaches trunk circuit 224 the trunk operates relay 233 which initiates the connection of trunk 224 over a set of conductors indicated by conductor 228, a primary sender switch 240 and secondary switch 241, conductor 229 to an idle terminating sender such as that of Fig. 6.

In addition relay 233 grounds conductors 242 and 243 to identify the frame on which trunk 224 is located and grounds conductor 244 to indicate that the incoming trunk is individual to office A. When the sender is seized ground is connected to conductor 249, operating relay 602 to connect the sender equipment with the sender link circuits. At the same time relay 238, which is individual to this sender group in the link circuit, is operated, connecting conductors 242, 243 and 244 to conductors 245, 246 and 247, respectively.

With relay 602 operated, conductor 245 is extended to the winding of relay 603, conductor 246 is extended to the frame register and conductor 247 is extended to the winding of relay 610. Relay 603 locks to conductor 606 and relay 610 locks to conductor 614, conductors 606 and 614 being grounded under the control of off-normal relay 612. The operation of relay 603 indicates that the number of the frame on which trunk circuit 224 is located is less than ten while the setting of the frame register records the units digit of

the frame number. The operation relay 610 indicates that the incoming trunk is individual to office A.

Both relays 603 and 605 and both relays 610 and 611 should not be simultaneously operated and therefore, with relays 603 and 610 operated and relays 605 and 611 not operated, a circuit is established for relay 613 extending from battery through the winding of relay 613, upper front contact of relay 610, back contact of relay 611, back contact of relay 605 to ground. Relay 613 operates, locks under the control of relay 612 and conditions the sender for operation. As fully disclosed in the Patent 2,089,921 to Carpenter hereinbefore referred to, the terminating sender proceeds to transmit series of reverberative impulses to the originating sender of Fig. 1 to satisfy the sender with respect to its numerical digit registration. Five series of impulses are transmitted, the second of which is recorded on the incoming group register 630. For a call to office A the precise numerical designation is of no interest, but it may be noted that one of the lower four cross-points will be closed, for example cross-point 631.

When the complete numerical designation has been transferred, a signal is transmitted to the originating sender to cause its release and the terminating sender is associated with an idle terminating marker over the marker connector 620. It will be assumed that the marker shown in Figs. 7, 8, 9, and the lower part of Fig. 3 is available and becomes connected with the sender of Fig. 6. Following the connection of the marker with the sender, circuits are closed for transferring the numerical and frame designations to the marker, and for giving the marker an indication of the office in which the called line is located.

Upon the association of the sender with the marker, a plurality of control circuits are established over which the digits of the registered wanted line designation are transferred from the sender to the marker and recorded in groups of register relays represented by thousands relay 815, hundreds relay 816, tens relay 817 and units relay 818. The hundreds relay 816 indicates whether the hundreds digit is greater or less than five by operating relay 819 for digits greater than five and indicates the position of the digit in either series by operating one of five relays such as relay 820. The thousands relay 815 marks one of ten conductors, such as conductor 821, which is extended to either conductor 852 or 853 according as relay 819 is or is not operated.

The tens register represented by relay 817 discriminates between even and odd digits by operating relay 826 for odd digits and identifies blocks of twenty numbers by operating one of a set of five relays such as relay 827 which in turn operates relays such as relay 828. The units register relay 818 grounds one of ten conductors which are extended to twenty conductors according to the operated or non-operated condition of relay 826. The frame register 604 transfers its registration to a frame register in the marker represented by relay 840.

At the same time ground is connected to conductors 801, 802, 803 and 804 to perform a test of the register setting circuits in the manner described in the Carpenter Patent 2,089,921 above mentioned. Ground on conductor 804 completes a circuit through the marker connector 620 to conductor 624, upper front contact of relay 603, conductor 625, through the marker connector 620, conductor 805, to the winding of relay 808. Ground on conductor 803 completes a circuit

through the marker connector 620, to conductor 623, inner right contact of cross-point 631, conductor 626, lower contact of relay 610, conductor 627, through the marker connector 620 to conductor 807, winding of relay 811 to battery. After the completion of the test, ground is removed from conductors 801 to 804 and relays 808 and 811 release.

Following the release of relay 811 ground is connected to its armature, completing a circuit over the back contact of relay 811 to the winding of office A relay 813 and battery. With relay 813 operated conductors 852 and 853 are extended to the windings of relays 822 and 823. Therefore, the joint operation of the thousands and hundreds register relays and office A relay 813 identifies one of twenty groups of five hundred lines each by operating one of the set of twenty relays such as relays 822 and 823 allocated to office A. A similar set of relays is provided for office B.

The joint operation of relay 820 and either relay 822 or relay 823 selects a number of group frame in the office unit A by completing a circuit for a marker preference relay such as relay 402 or 406. In each number group connector, there is a marker preference relay for each marker and these preference relays are arranged in a chain circuit so that only one marker can attach itself to a number group frame at a time. Assuming that relay 819 has been operated, a circuit was closed from ground over the back contact of relay 338, conductor 341, contact of relay 815, front contact of relay 819, contact of relay 813 to the winding of relay 823 causing the operation of relay 823. The circuit of relay 406 is closed to battery on conductor 330 as soon as frame 401 becomes idle. Relay 406 operates multicontact relay 407, which closes the necessary circuits between the marker and the number group frame. With relay 407 operated, the hundred block relay 408 is operated under the control of relays 823 and 820, there being one relay 408 for each one hundred numbers included in the number group. With relay 408 operated, twenty block relay 409 is operated under the control of relays 828 and 408, there being one such relay for each twenty numbers in the number group frame.

As soon as the number group frame has been seized, ground is supplied to cause the marker to connect with the frame on which the incoming trunk circuit is located. To this end a marker preference relay 308 is operated, when the frame is free, over conductor 331, back contact of frame tens relay 808, and the front contact of frame relay 840. Relay 308 operates multicontact relay 309 which closes through circuits for testing and operating the incoming switches shown in Fig. 4 and other control circuits in addition to the circuits shown. At the same time a signal is transmitted to the incoming trunk 224 which causes it to connect with the incoming frame connector by operating relay 301. This relay establishes test and control circuits which are not shown and also grounds two circuits. At its outer contact it grounds conductor 332 completing a circuit over a contact of relay 309 for relay 315 in the marker to indicate that the calling office, office X, is a full selector type office. At its inner contact it connects ground over a contact of relay 309 to conductor 333, the winding of relay 700 and battery to indicate that the trunk group is individual to a physical office (office A).

At the number group frame the hundred block

relay 408 connected ground over a contact of relay 407 to conductor 460, operating relay 701 as an indication that the group of one hundred numbers requires no discrimination, since office A includes no theoretical office.

With relays 409 and 407 operated, twenty sets of three terminals each on the number frame 401 such as 410 to 412 and 413 to 415 are marked by connecting them to equipment in the marker. For example, terminal 410 is connected over front contacts of relays 409 and 407 and the back contact of relay 829 to the winding of busy test relay 831, while terminal 413 is similarly connected over a back contact of relay 830 to the winding of busy test relay 832. The corresponding terminals on the other eighteen sets are also connected to intermediate relays in the set of busy test relays. Terminals 411 and 414 are connected to armatures of selecting relays 829 and 830, respectively, and the corresponding terminals of the remaining sets are connected to armatures of intermediate relays of this group. Terminals 412 and 415 are connected over back contacts of relays 829 and 830 to the windings of relays 833 and 834 which become effective only in case of terminal hunting groups.

In order to connect with a wanted line it is necessary to select the choice, the frame and the level of the frame on which the line is located and also to determine whether the called line is one of a terminal hunting group or not and whether ringing is to be sent on the tip or ring side of the subscriber's line. Therefore, there is provided in the marker a group of line choice relays 900, 901, etc. there being one for each choice. Since each choice includes four frames with ten levels on each frame, a set of twenty double wound relays 902 to 905 is provided, each pair of relays 902 and 903 or 904 and 905, representing one of the ten levels and each relay representing a pair of frames, the two windings of each relay distinguishing between frames of the pair. In order to differentiate between the types of service, the line choice relays 900, 901, etc., have three windings each and are energized over the different windings in accordance with the type of service to which the line is entitled. Therefore, there is a maximum of thirty conductors leading from the line choice relays and a maximum of forty conductors outgoing from the frame or level relays. These conductors are extended in multiple to all of the number frame connector relays such as 407, 403, 457 and 453 and over contacts of these relays to sets of terminal strips on the number group frames. The operating conductors 906, 907 and 908 for relay 900 extend to terminal strips 417, 418 and 419 and similarly the operating conductors 909 to 912 for the frame level relays 902 and 903 are connected over contacts of relay 407 to terminal strips 420 to 423, it being assumed that connector relay 407 is operated.

The subscriber's line 530 of the office unit A where it enters the office is connected to a distributing frame 503 from which the line is extended to one of the primary line switches 501 in accordance with the traffic requirements. The line itself is connected to the line terminals 504 and 505 while individual to the line terminals 504 and 505 are the sleeve or busy terminal 506 and the message register terminal 507.

At the number frame, assuming that the set of number terminals 410, 411 and 412 represent the number assigned to line 530, terminal 410 will be cross-connected over jumper 424 to ter-

minal 506 individual to the position in the primary switch 501 assigned to the line 530. According to the present disclosure line 530 appears in the No. 0 level of the No. 0 frame in the No. 0 choice and is an individual message rate line. Therefore, terminal 411 is connected over jumper 425 to strip 420 and terminal 412 is connected over jumper 426 to strip 417.

When the twenty block relay 409 operates as above described, the sleeve test circuit for line 530 extends from battery through the winding of relay 831, back contact of relay 829, over front contacts of relays 407 and 409, terminal 410, jumper 424, to the sleeve terminal 506 individual to the line. If the line is busy relay 831 operates from the busy ground on the sleeve of the line. At the same time, battery through the winding of relay 833 is connected over the back contact of relay 829, conductor 836, over contacts of relays 407 and 409, terminal 412, thence over jumper 426, strip 417, contact of relay 407, conductor 906, left winding of relay 900 to battery. Therefore, relay 833 does not operate. After an interval to permit the busy test relays 831, 832, etc. to operate, relay 340 operates and ground is connected over the front contact of relay 340, back contact of relay 339, to conductor 342, and thence under the control of the units register to conductor 835, thereby operating relay 829, provided relay 831 is not operated. With relay 829 operated, ground is connected to conductors 836 and 837. Conductor 836 extends to terminal 412, thence over jumper 426, strip 417, conductor 906, left winding of relay 900 to battery. Relay 900 operates over this circuit to identify the No. 0 line choice and thereupon extends its operating ground to the winding of relay 913 to indicate that the wanted line is to be handled as an individual line. Conductor 837 extends to terminal 411, thence over jumper 425 to strip 420, conductor 909, left winding of relay 902 to battery. Relay 902, upon operating, identifies the No. 0 level and extends its operating ground over its inner left contact to the winding of relay 914 to identify the No. 0 frame. It may be noted that relays 914 to 917 represent the four frames of a choice and are operated from the corresponding energizing circuits for each pair of frame level relays.

With relay 900 operated, if the incoming connector has been operated, the No. 0 line choice is selected by operating the marker preference relay 508 individual to the marker shown in the No. 0 line choice connector. The marker preference relay operates the multicontact relay 509 which extends all of the control circuits from the marker through to the choice. The frame relay 914 closes a circuit from ground through the winding of relay 918 to the winding of relay 510 which is individual to the No. 0 frame, over equipment (not shown) which determines whether the frame equipment is free to handle a terminating call. Relay 918 operates if the frame equipment is idle and connects ground to the outer left contacts of the level relays 902, 904, etc. and, since relay 902 is assumed to be operated, operates horizontal level relay 511. Relay 511 connects the operating circuits for the ten select magnets, corresponding to the ten line junctors which serve the wanted line, through to the marker where one will be selected as described in detail in the Dehn et al. patent. The hold magnet 512 of this line is operated over the front contact of relay 829 after an idle channel has been selected.

When the class relay such as relay 913 is oper-

ated, it sets up a ringing registration in the marker. The marker subsequently transfers this registration to the incoming trunk circuit, at the same time operating a check relay in the marker which is held operated over the locking circuit of the trunk circuit relay. As a part of the present invention the circuit which supplies ground for operating the ringing control relays of the junctor is extended to determine that the incoming trunk and the called line group agree. With relay 701 operated to indicate an unrestricted group, a circuit is closed from ground over the lower front contact of relay 315, conductor 334, inner left contact of relay 701 to conductor 704 which leads to the operating circuit for the trunk ringing relays and the check relays. The marker tests the check relays against the ringing registration, releases a relay in the junctor to permit it to connect with the incoming switches and then releases.

If the subscriber at office X wished to call a subscriber in office BP, one of the group of trunks 123, terminating in trunk circuit 223 would be selected. Trunk circuit 223 operates relay 235 which for convenience is shown as grounding the frame identifying conductors 242 and 243 which were grounded previously. Relay 235 also grounds conductor 250 which is extended by sender group relay 238 to conductor 248. When relay 602 operates, relay 611 operates over conductor 248 and locks to conductor 614. When the sender and marker are connected, relay 611 connects direct ground to conductor 627 so that relay 811 remains operated after the temporary ground is removed from conductors 801 to 804. With relay 811 held operated, office B relay 814 is operated in place of relay 813 to prepare the circuits of the relays 824, 825, etc. in place of relays 822, 823, etc. Assuming that the same number has been registered, the five hundred group relay 825 is operated, followed by marker preference relay 456. Relay 456 operates multicontact relay 457 whereupon hundred block relay 458 and twenty block relay 459 are operated. Hundred block relay 458 connects ground to conductor 461, completing a circuit for relay 705.

In the incoming connector, trunk circuit 223 operates relay 302 which again operates relay 315 to indicate that the calling office is a full selector office, and grounds conductor 333 to operate relay 700 to indicate that the incoming trunk relates to a physical office.

With relay 705 operated from the number group and relay 700 operated from the incoming connector, the ringing control circuit extends as previously traced to conductor 334, over the middle left contacts of relays 700 and 705 to conductor 704.

For a call to the theoretical office, office BT, one of the group of incoming trunks including trunk circuit 222 is used. Relay 236 is operated, grounding conductor 250, which results in the operation of relay 811 as before. In this case a number is registered which is within the group constituting the theoretical office. Assuming that this group of numbers is the one hundred numbers to which hundred block relay 454 is individual, that relay when operated connects ground over a contact of relay 453 and conductor 462 to the winding of relay 706 and battery.

Trunk 222 also operates relay 303 in the incoming connector which relay again operates relay 315 and connects ground over a contact of relay 309 and conductor 335 to the winding of relay 707 and battery. With relays 706 and 707 oper-

ated, the ringing control circuit extends as above traced to conductor 334, over the middle left contacts of relays 707 and 706 to conductor 704.

It may be noted that the lines constituting the theoretical office may be located anywhere desired in the office unit, since the number group transmits the necessary information for selecting these lines in the same manner as for the physical lines.

The physical office BP and the theoretical office BT being really portions of the same ten thousand line office unit, it would be possible to reach a line in either of these offices from any trunk incoming to the unit. Since the purpose of establishing the theoretical office is to cause the office unit to be selected over trunks equipped to make a special charge, means must be provided to discriminate between the two offices.

As above described, trunks incoming to office A or to physical office BP operate relay 700, while trunks incoming to theoretical office BT operate relay 701.

From the number groups of office A, which has no theoretical office, relay 701 is operated to indicate that no discrimination is required. Physical office number groups constituting office BP operate relay 705, while the number groups in the theoretical office BT operate relay 706.

If now, a subscriber dials the code of the office BP followed by a number in office BT accidentally or in an attempt to avoid the charge, relays 700 and 706 will be operated. Relay 700 closes an obvious circuit for relay 702 which locks to ground over conductor 703. Relay 702 also extends ground from conductor 703 over its second front contact, conductor 709, back contact of relay 320, conductor 336, back contact of relay 701, outer right front contacts of relays 706 and 700, back contact of relay 708, conductor 710, back contacts of relays 321, 319, 314 and 313, inner upper back contact of relay 317, upper back contact of relay 316, upper front contact of relay 315, to the winding of relay 311 and battery. Relay 311 controls the routing of a call to an intercept operator. At its outer lower contact it operates relay 338 which opens the circuit of the five hundred relay 823, for example, thereby causing the release of the previously operated number frame and in turn, of the incoming connector and the line choice connector. When all of these connectors are normal, relay 339 operates over the left contact of relay 338. At its upper contacts, relay 311 prepares circuits for operating a marker preference relay, a hundred block relay, a twenty block relay and one of the group of relays 829, 830, etc. These circuits are completed by relay 339 and are extended in multiple to relay 813 and relay 814. Since the call was directed to office unit B, relay 814 will be operated to further extend these circuits in multiple to contacts of relays 702 and 711. With relay 702 operated the circuits are extended to the second group of cross-connecting terminals which are so connected as to cause the calling line to be connected with one of a group of trunks at an intercepting position which are individual to the B physical office.

If a call were attempted in which code of office BT were dialed followed by a number located in office BP, relays 707, 705 and 711 would be operated and the circuit above traced for relay 311 would be closed, extending in this case from ground to conductor 336 over the back contact of relay 701, outer right front contacts of relays 705 and 707, back contact of relay 708 to con-

ductor 710 and thence to the winding of relay 311.

Intercept relay 311 is also used for calls from manual offices which operate relay 316, the circuit in that case extending over the back contact of relay 315, and the front contact of relay 316 but otherwise as above traced. Relay 312 is used in intercepting calls from a toll office and when operated prepares circuits for selecting one of a group of trunks individual to toll calls appearing at an intercept operator's position. Relay 813 or 814 distributes the circuits to either A or B office and relays 702 and 711 further distribute them to physical or theoretical office trunks. Since under the present assumption there is no theoretical office associated with office A, the two outer sets of cross connections controlled by relay 711 would not be completed.

Relay 311 is also operated whenever an unused number is dialed resulting in the operation of relay 319 or if the ringing relays are not set properly. The latter circuit is indicated as a contact of relay 322 but may be traced in detail in the above-identified Dehn et al. patent.

Relay 313 or relay 314 is operated under the control of relay 318 if the line called is in trouble and has been so marked by the maintenance force. These relays extend such calls to the intercepting operator's position over different groups of trunks from those employed by relays 311 and 312. Discrimination is made between office unit A and office unit B but not between the physical and theoretical line groups.

In the case of groups of trunks from offices for which no discrimination is desired between the physical and theoretical offices, relays such as 306 or 307 are operated in the incoming connector. These relays connect ground over a contact of relay 309 to conductor 337, operating relay 708. This relay closes the ringing control circuit at its inner left contact and opens the circuit for the intercept relay 311 at its back contact. Similarly relay 701, which operates from number groups requiring no discrimination, opens the circuit of relay 311.

Relay 712 is the four-party ringing control relay. This relay is operated, for example, over the third contact of relay 711, conductor 713, second contact of relay 814, front contact of relay 819 to ground. It may also be operated over contacts of relay 702 and contacts of either relay 813 or 814. This circuit is carried over contacts of relays 813, 814, 711 and 702 in order to furnish four-party ringing to the office units as desired. As shown, it is furnished to all three office units but by opening any one of these circuits four-party ringing may be restricted to one or two offices.

As pointed out in the Hersey et al. patent above identified, if the incoming frames are individual to the A and B offices so that each office will have ten or less incoming frames, the frame tens relays 603 and 605 may be used to set up the office registration while relays 611 and 610 may be omitted or used to control relays 700 and 707 in place of the incoming connector. In that case the alternate wiring 841 shown between conductor 805 and relay 811 is used so that relay 603 operates relay 811 from ground on conductor 624 while relay 605 operates relay 811 from direct ground. Similarly the alternate wiring is used in the circuit for relay 613, by-passing relays 610 and 611.

From certain offices the traffic to offices A and B may be insufficient to warrant special groups of trunks. Where a trunk group is common to the

two offices, relay 610 is operated and the originating office discriminates by adding five pulses to those normally transmitted for the incoming group selection. For such a registration, one of the upper five cross-points is closed, and direct ground is connected over the inner right contact of the cross-point and the lower front contact of relay 610 to conductor 627 to hold relay 811 operated and cause the call to be routed to office B.

If more than one trunk group relay or more than one number group relay is operated a trouble condition is recorded, the trouble indicator operated and the marker released to permit a second trial. Thus, if relay 708 is operated with either relay 700 or relay 707 a circuit is closed from ground at the right contact of relay 708, over the inner left contact of either relay 700 or relay 707 to the winding of relay 714 and battery. Relay 714 calls in the trouble indicator. If relays 700 and 707 are both operated a circuit is closed from ground over the inner right contacts of relays 700 and 707 to the winding of relay 714. Similarly, if relay 701 is operated with either relay 705 or relay 706 or if relays 705 and 706 are operated together a circuit is completed for relay 714, thereby insuring the proper functioning of the discriminating relays.

Relay 715 is the free-call relay and is operated whenever a call is directed to a free line. Since this relay also closes the ringing control circuit to bring about the release of the marker, calls to free lines are made without discrimination.

What is claimed is:

1. In a telephone system, a plurality of offices, trunks incoming to each of said offices, called lines in each of said offices, control equipment common to said offices, means to connect said control equipment to any one of said trunks, means to connect said control equipment with any one of said lines, switching equipment under the control of said control equipment by which a connection may be extended from any one of said trunks to any one of said lines, and means in said control equipment for preventing the connection of a trunk incoming to one of said offices with a line in the other of said offices.

2. In a telephone system, a plurality of offices, trunks incoming to each of said offices, called lines in each of said offices, control equipment common to said offices, means to connect said control equipment to any one of said trunks, means to connect said control equipment with any one of said lines, switching equipment under the control of said control equipment by which a connection may be extended from any one of said trunks to any one of said lines, means in said control equipment operated by said trunk connecting means in response to connection with a calling trunk for identifying the office to which said trunk is incoming, means operated by said line connecting means to identify the office in which the called line is located and means operated if said two identifying means identify different offices to prevent the connection of said trunk with said line.

3. In a telephone system, a plurality of offices, trunks incoming to each of said offices, called lines in each of said offices, control equipment common to said offices, means to connect said control equipment to any one of said trunks, means to connect said control equipment with any one of said lines, switching equipment under the control of said control equipment by which a connection may be extended from any one of said

trunks to any one of said lines, means in said control equipment operated by said trunk connecting means in response to connection with a calling trunk for identifying the office to which said trunk is incoming, means operated by said line connecting means to identify the office in which the called line is located, an operator's position, and means operated if said two identifying means identify different offices to connect said trunk with said operator's position.

4. In a telephone system, a plurality of offices, trunks incoming to each of said offices, called lines in each of said offices, control equipment common to said offices, means to connect said control equipment to any one of said trunks, means to connect said control equipment with any one of said lines, switching equipment under the control of said control equipment by which a connection may be extended from any one of said trunks to any one of said lines, means in said control equipment operated by said trunk connecting means in response to connection with a calling trunk for identifying the office to which said trunk is incoming, means operated by said line connecting means to identify the office in which the called line is located, an operator's position, means operated if said two identifying means identify different offices to connect said trunk with said operator's position, and means at said position to indicate to which office said trunk was incoming.

5. In a telephone system, an office unit identified by one office code, lines terminating at said office unit, a group of lines within said office unit requiring a special charging rate and identified by a second office code, groups of trunks incoming to said office unit individual to each of said office codes, switching means for connecting an incoming trunk with a wanted line, control equipment for operating said switching means, a trunk connector for connecting said control equipment with an incoming trunk, a line connector for connecting said control equipment with a called line, means in each connector for setting up a registration in said control equipment and means responsive to said registrations for controlling the completion of a connection between said trunk and said line.

6. In a telephone system, an office unit identified by one office code, lines terminating at said office unit, a group of lines within said office unit requiring a special charging rate and identified by a second office code, a group of trunks selectable by said one office code, a second group of trunks selectable by said second office code, a third group of trunks selectable by either of said office codes, switching means for connecting an incoming trunk with a wanted line, control equipment for operating said switching means, a trunk connector for connecting said control equipment with an incoming trunk, a line connector for connecting said control equipment with a called line, means in said trunk connector operated in accordance with the type of trunk group for setting up a corresponding registration in said control equipment, means in said line connector for setting up a registration in said control equipment indicating that the called line is or is not in said group of lines and means controlled by said registrations for preventing the completion of a connection if a line in said group of lines is called over a trunk of said first trunk group.

7. In a telephone system, an office unit identified by one office code, lines terminating at said office unit, a group of lines within said office unit

requiring a special charging rate and identified by a second office code, a group of trunks selectable by said one office code, a second group of trunks selectable by said second office code, a third group of trunks selectable by either of said office codes, switching means for connecting an incoming trunk with a wanted line, control equipment for operating said switching means, a trunk connector for connecting said control equipment with an incoming trunk, a line connector for connecting said control equipment with a called line, means in said trunk connector operated in accordance with the type of trunk group for setting up a corresponding registration in said control equipment, means in said line connector for setting up a registration in said control equipment indicating that the called line is or is not in said group of lines, means controlled by said registrations for preventing the completion of a connection if a line in said group of lines is called over a trunk of said first trunk group and means for permitting the completion of a connection if a line in said group of lines is called over a trunk of said second or third trunk groups.

8. In a telephone system, an office unit identified by one office code, lines terminating at said office unit, a group of lines within said office unit requiring a special charging rate and identified by a second office code, a group of trunks selectable by said one office code, a second group of trunks selectable by said second office code, a third group of trunks selectable by either of said office codes, switching means for connecting an incoming trunk with a wanted line, control equipment for operating said switching means, a trunk connector for connecting said control equipment with an incoming trunk, a line connector for connecting said control equipment with a called line, means in said trunk connector operated in accordance with the type of trunk group for setting up a corresponding registration in said control equipment, means in said line connector for setting up a registration in said control equipment indicating that the called line is or is not in said group of lines and means controlled by said registrations for connecting said incoming trunk with a trunk leading to an operator's position if a line in said group of lines is called over a trunk of said first trunk group.

9. In a telephone system, an office unit identified by one office code, lines terminating at said office unit, a group of lines within said office unit requiring a special charging rate and identified by a second office code, a group of trunks selectable by said one office code, a second group of trunks selectable by said second office code, a third group of trunks selectable by either of said office codes, switching means for connecting an incoming trunk with a wanted line, control equipment for operating said switching means, a trunk connector for connecting said control equipment with an incoming trunk, a line connector for connecting said control equipment with a called line, means in said trunk connector operated in accordance with the type of trunk group for setting up a corresponding registration in said control equipment, means in said line connector for setting up a registration in said control equipment

indicating that the called line is or is not in said group of lines and means controlled by said registrations for connecting said incoming trunk with a trunk leading to an operator's position if the code of said trunk group and the code of the called line do not correspond.

10. In a telephone system, an office unit identified by one office code, lines terminating at said office unit, a group of lines within said office unit requiring a special charging rate and identified by a second office code, a group of trunks selectable by said one office code, a second group of trunks selectable by said second office code, a third group of trunks selectable by either of said office codes, switching means for connecting an incoming trunk with a wanted line, control equipment for operating said switching means, a trunk connector for connecting said control equipment with an incoming trunk, a line connector for connecting said control equipment with a called line, means in said trunk connector operated in accordance with the type of trunk group for setting up a corresponding registration in said control equipment, means in said line connector for setting up a registration in said control equipment indicating that the called line is or is not in said group of lines and means controlled by said registrations for connecting said incoming trunk with a trunk leading to an operator's position if the code of said trunk group and the code of the called line do not correspond, and means under the control of said trunk group registration to select the trunk to the operator's position.

11. In a telephone system, an office unit identified by one office code, lines terminating at said office unit, a group of lines within said office unit requiring a special charging rate and identified by a second office code, a group of trunks selectable by said one office code, a second group of trunks selectable by said second office code, a third group of trunks selectable by either of said office codes, switching means for connecting an incoming trunk with a wanted line, control equipment for operating said switching means, a trunk connector for connecting said control equipment with an incoming trunk, a line connector for connecting said control equipment with a called line, means in said trunk connector operated in accordance with the type of trunk group for setting up a corresponding registration in said control equipment, means in said line connector for setting up a registration in said control equipment indicating that the called line is or is not in said group of lines and means controlled by said registrations for connecting said incoming trunk with a trunk leading to an operator's position if the code of said trunk group and the code of the called line do not correspond, and means under the control of said trunk group registration to select a trunk to said operator's position individual to the type of incoming trunk.

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