

Nov. 4, 1941.

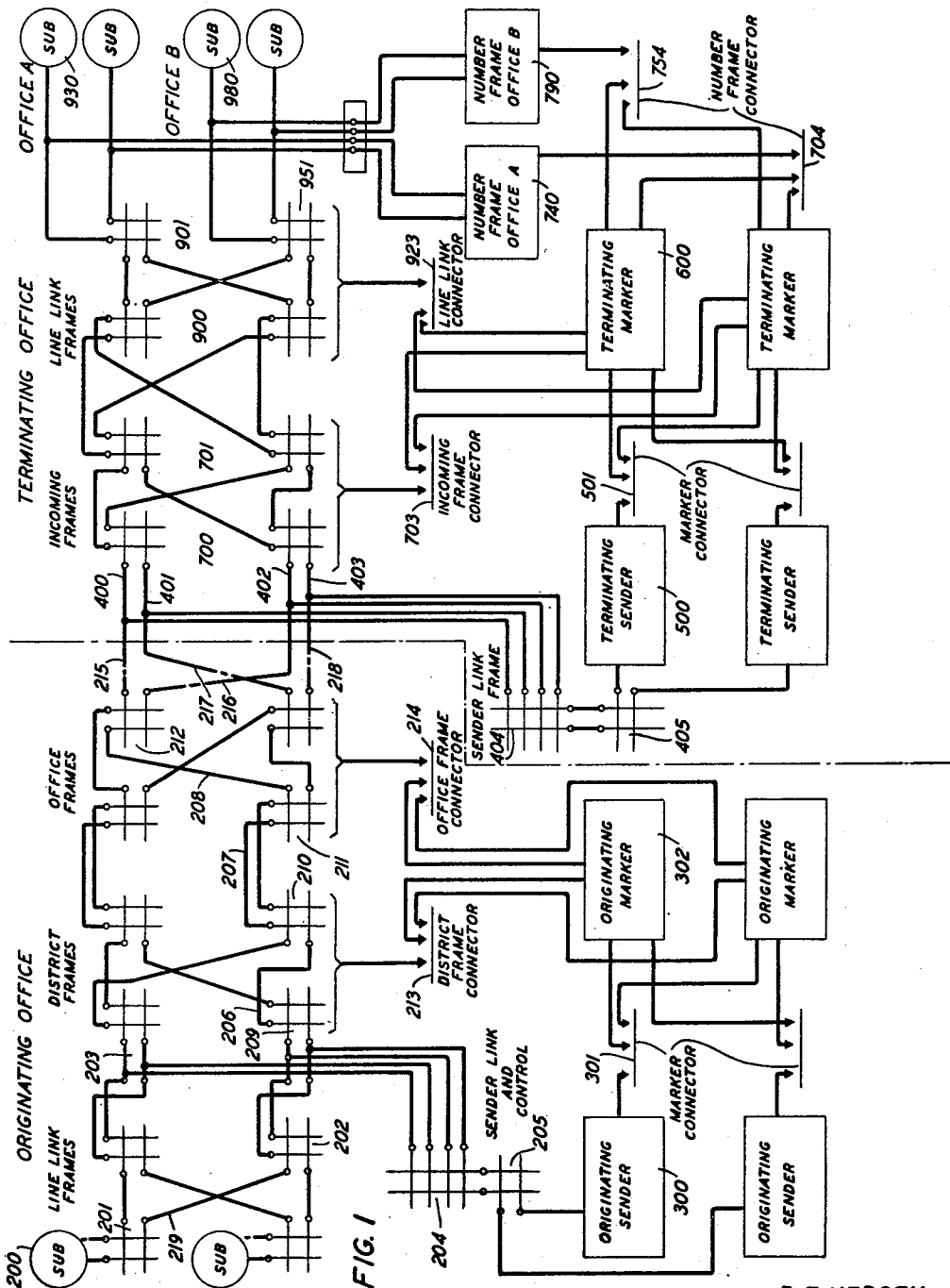
R. E. HERSEY ET AL

2,261,370

TELEPHONE SYSTEM

Filed May 15, 1940

9 Sheets-Sheet 1



R. E. HERSEY
INVENTORS: O. H. KOPP
O. MYERS
J. B. NEWSOM
BY *P. C. Smith*
ATTORNEY

Nov. 4, 1941.

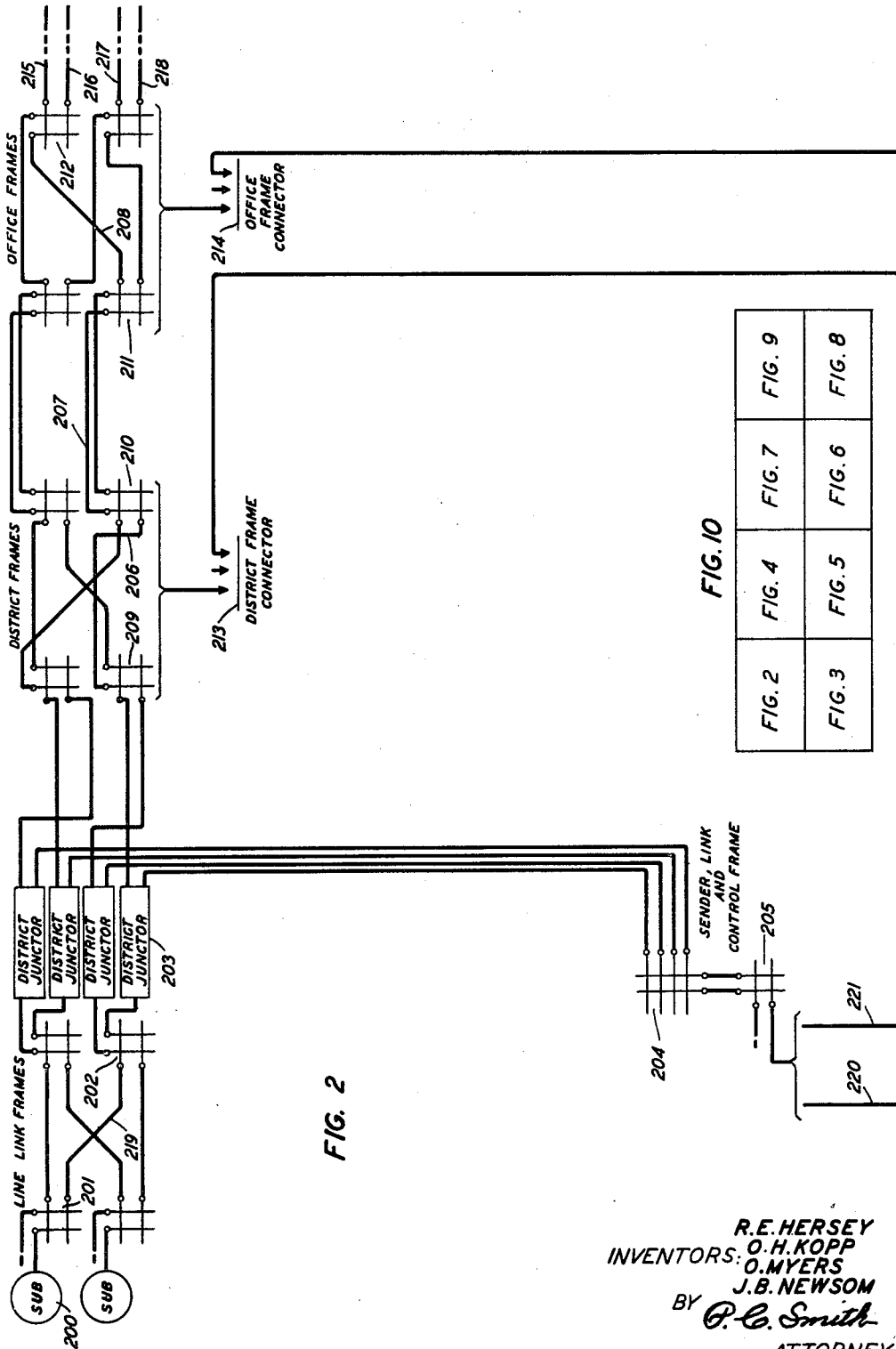
R. E. HERSEY ET AL

2,261,370

TELEPHONE SYSTEM

Filed May 15, 1940

9 Sheets-Sheet 2



Nov. 4, 1941.

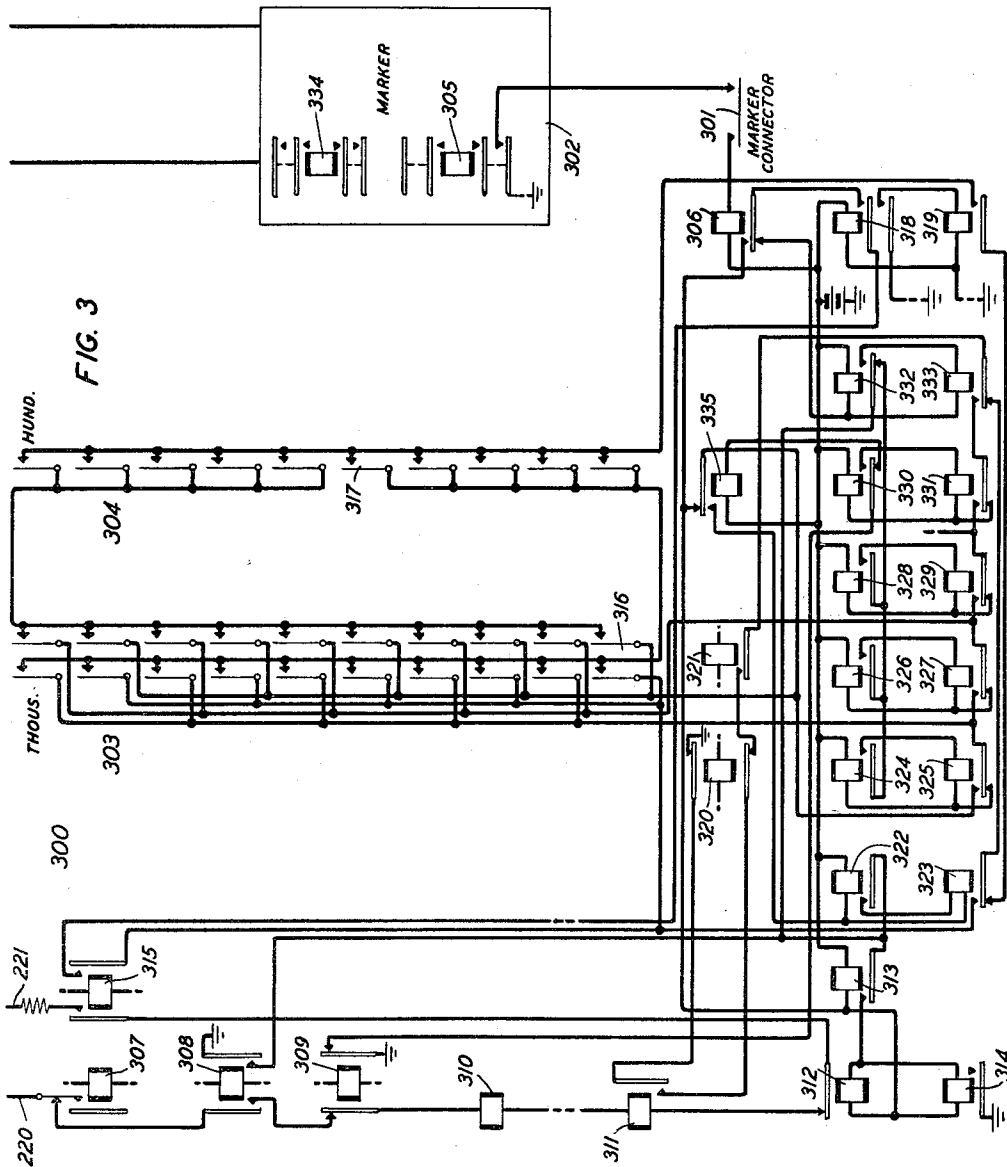
R. E. HERSEY ET AL

2,261,370

TELEPHONE SYSTEM

Filed May 15, 1940

9 Sheets-Sheet 3



R.E. HERSEY
O.H. KOPP
O. MYERS
J.B. NEWSOM
INVENTORS:
BY *P.C. Smith*
ATTORNEY

Nov. 4, 1941.

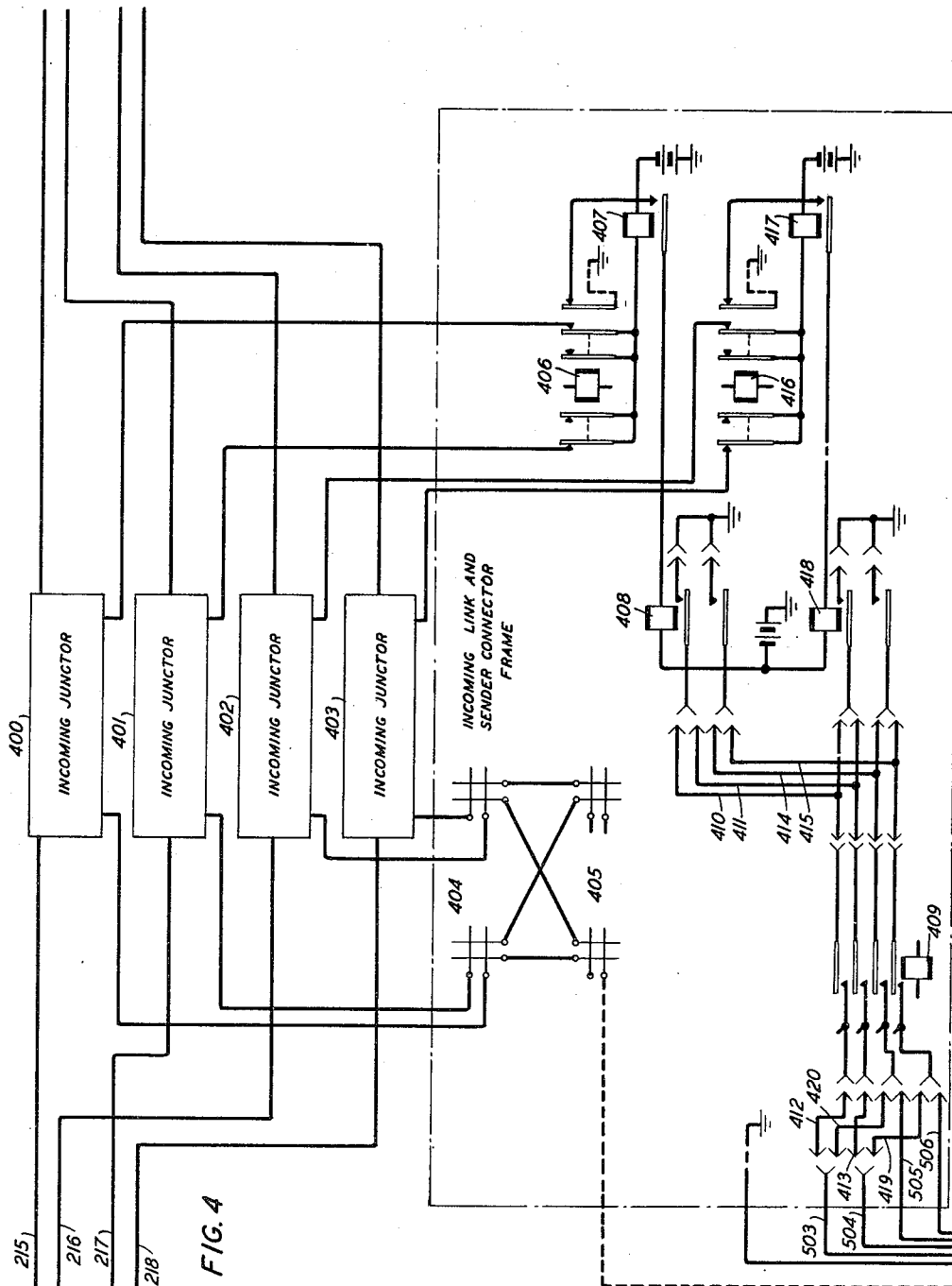
R. E. HERSEY ET AL

2,261,370

TELEPHONE SYSTEM

Filed May 15, 1940

9 Sheets-Sheet 4



R. E. HERSEY
INVENTORS: O. H. KOPP
O. MYERS
J. B. NEWSOM
BY *P. C. Smith*
ATTORNEY

Nov. 4, 1941.

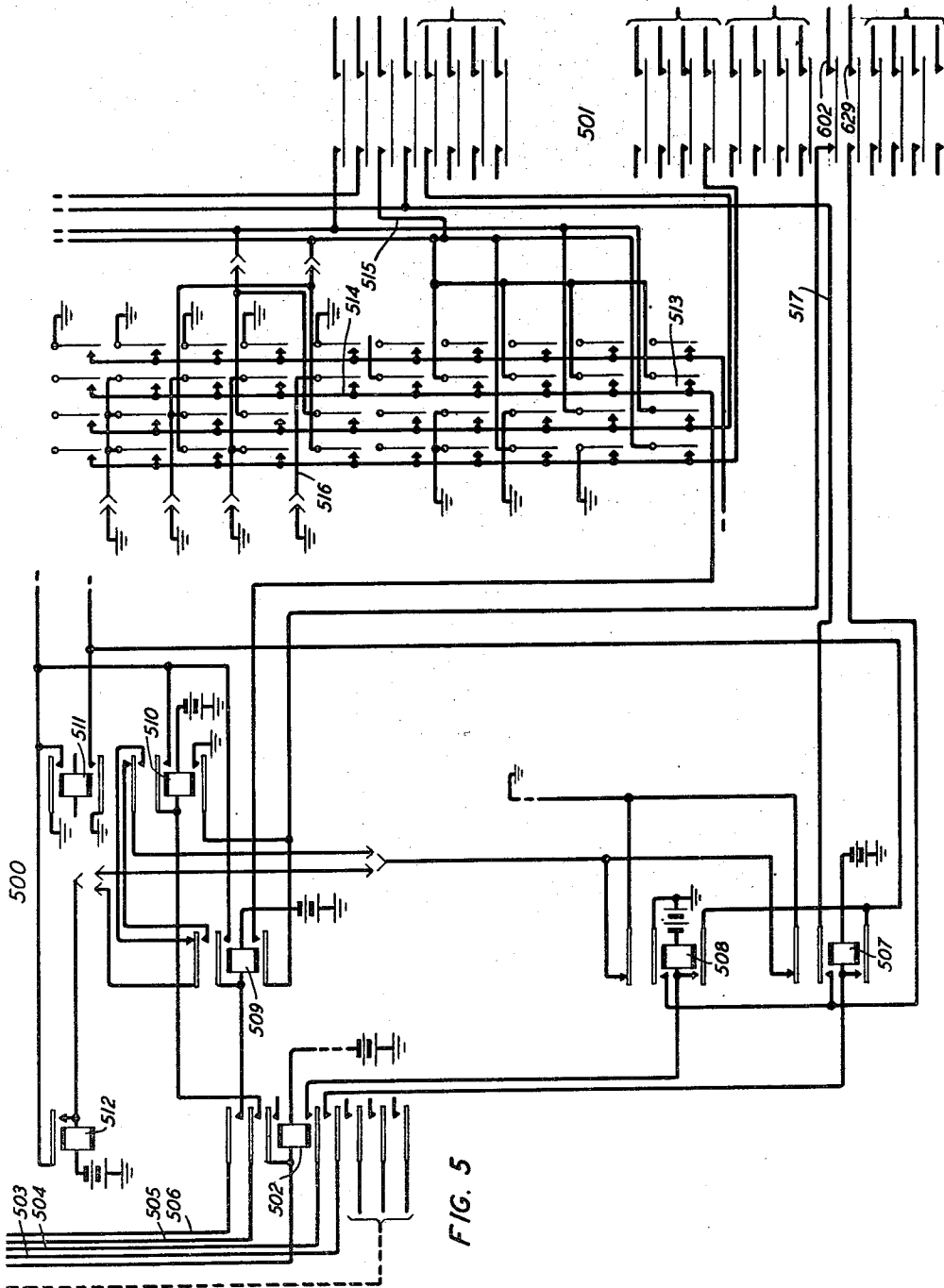
R. E. HERSEY ET AL

2,261,370

TELEPHONE SYSTEM

Filed May 15, 1940

9 Sheets-Sheet 5



R. E. HERSEY
INVENTORS: O. H. KOPP
O. MYERS
J. B. NEWSOM
BY *P. C. Smith*
ATTORNEY

Nov. 4, 1941.

R. E. HERSEY ET AL

2,261,370

TELEPHONE SYSTEM

Filed May 15, 1940

9 Sheets-Sheet 6

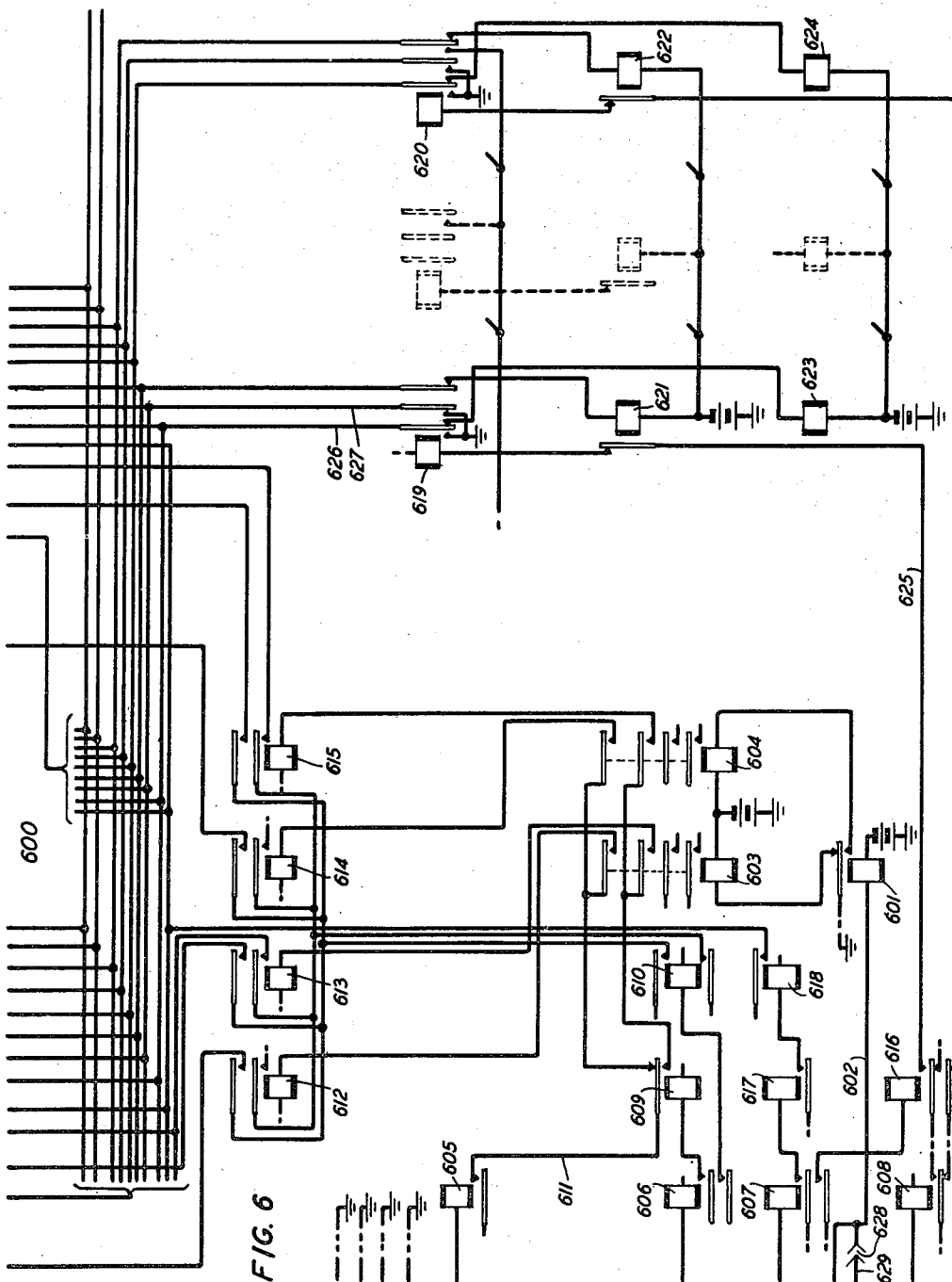


FIG. 6

R. E. HERSEY
O. H. KOPP
O. MYERS
J. B. NEWSOM

BY *P. C. Smith*
ATTORNEY

Nov. 4, 1941.

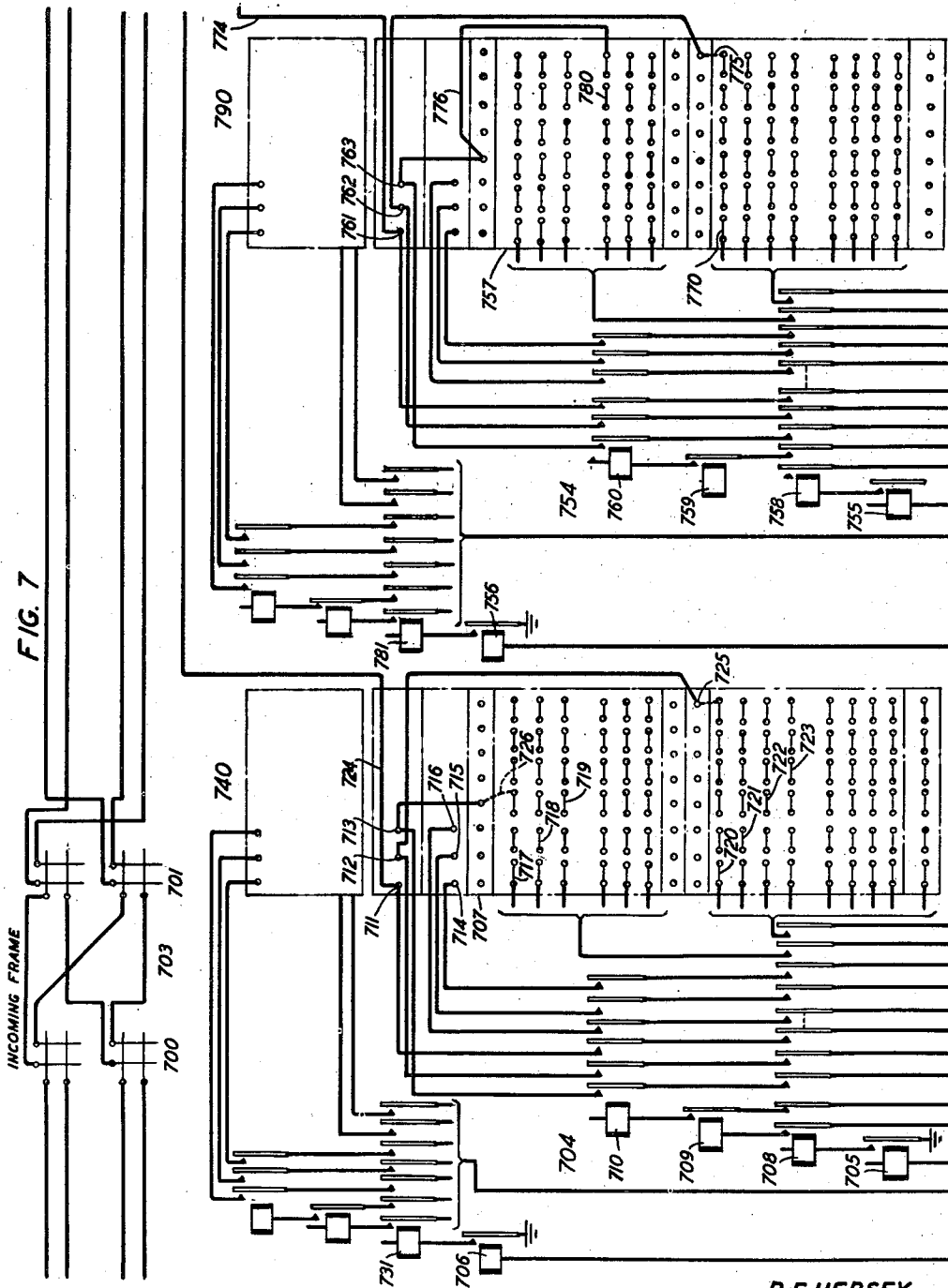
R. E. HERSEY ET AL

2,261,370

TELEPHONE SYSTEM

Filed May 15, 1940

9 Sheets-Sheet 7



R. E. HERSEY
O. H. KOPP
O. MYERS
J. B. NEWSOM
BY *P. C. Smith*
ATTORNEY

Nov. 4, 1941.

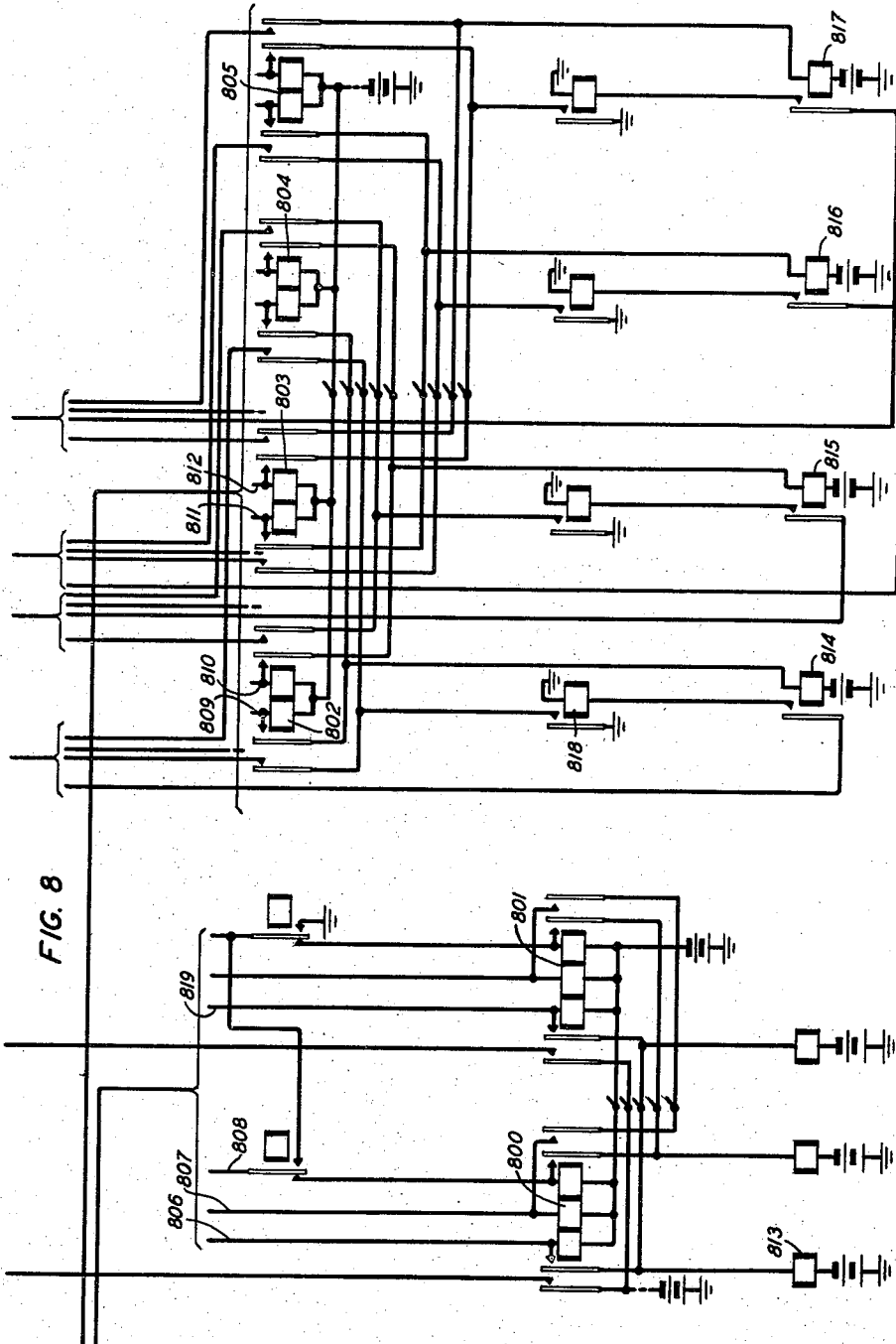
R. E. HERSEY ET AL

2,261,370

TELEPHONE SYSTEM

Filed May 15, 1940

9 Sheets-Sheet 8



R. E. HERSEY
O. H. KOPP
O. MYERS
J. B. NEWSOM
INVENTORS
BY *P. C. Smith*
ATTORNEY

Nov. 4, 1941.

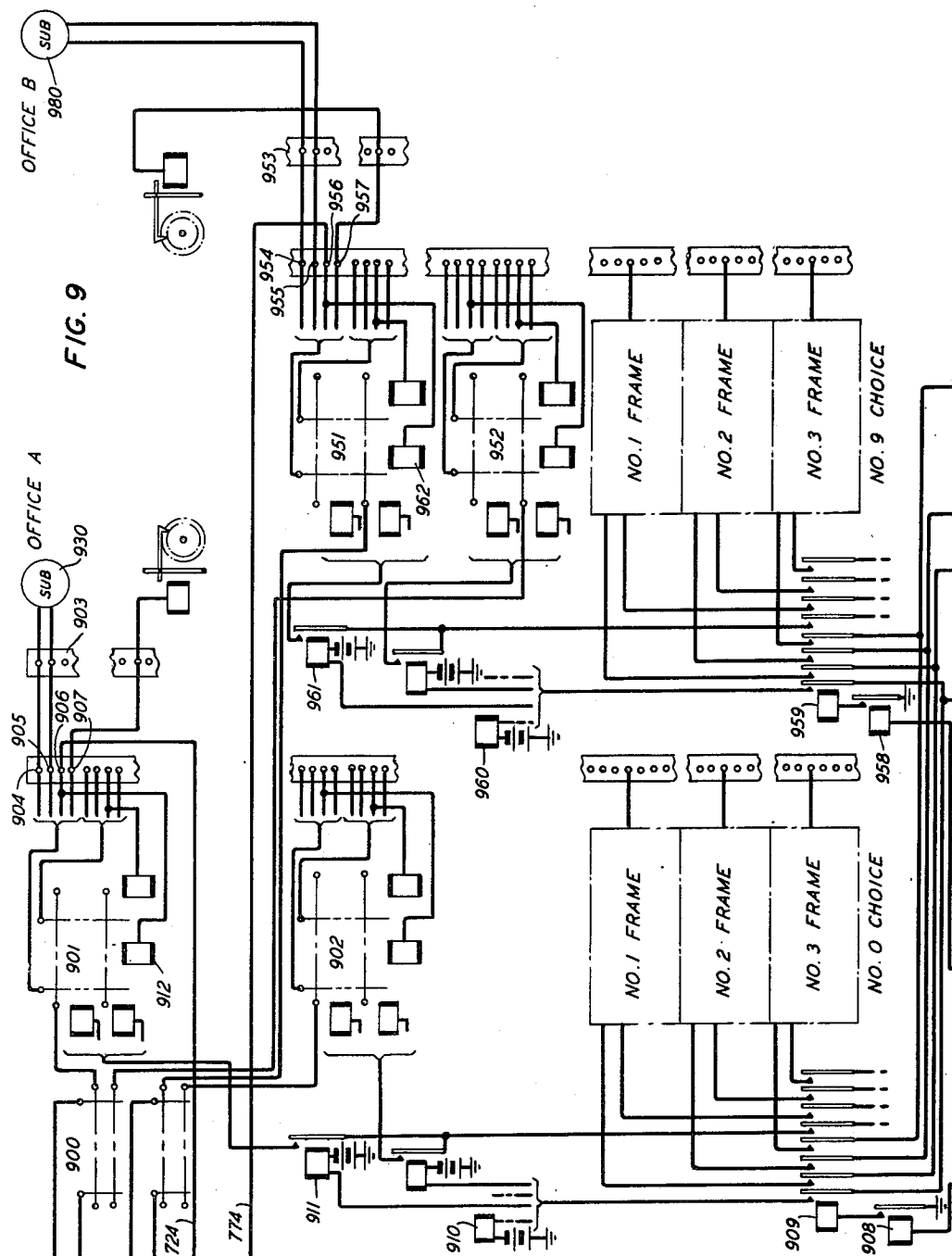
R. E. HERSEY ET AL

2,261,370

TELEPHONE SYSTEM

Filed May 15, 1940

9 Sheets-Sheet 9



R. E. HERSEY
O. H. KOPP
O. MYERS
J. B. NEWSOM
BY *P. C. Smith*
ATTORNEY

UNITED STATES PATENT OFFICE

2,261,370

TELEPHONE SYSTEM

Ralph E. Hersey, Madison, N. J., and Ottmar H. Kopp, Baldwin, Oscar Myers, Mount Vernon, and James B. Newsom, Great Neck, N. Y., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application May 15, 1940, Serial No. 335,241

10 Claims. (Cl. 179—18)

This invention relates to telephone exchange systems and more particularly to systems of the so-called cross-bar type for enabling the terminating equipment to be used in common for terminating calls in two offices serving a maximum of twenty thousand directory numbers.

In telephone exchange systems the exchange areas, are for convenience in establishing connections, divided into a plurality of offices each serving ten thousand subscribers' lines. Each of the offices is provided with switching equipment for establishing connections from subscribers' lines terminating therein to other lines which may terminate in the same or another office and is provided with originating sender and marker equipment for controlling a portion of the switching equipment on calls originating in the office and with terminating sender and marker equipment for controlling a further portion of the switching equipment to terminate calls incoming to the office. In some instances two offices may be located in the same office building and a considerable saving in equipment could be realized if the terminating equipment could be used in common for both offices.

It is therefore an object of the present invention to decrease the cost of equipping two offices which are located in the same building by combining the terminating equipment of the two offices in such a manner that both offices are served by the same terminating senders and markers and in some cases by the same incoming trunks, incoming frames and line-link frames.

In accordance with the present invention, the trunks incoming to such common terminating equipment serving two office units may be arranged in a common group selectable at an originating office in response to the dialing of the office code digits of either of the terminating office units or may, as an alternative, be in separate groups selected in response to the dialing of the respective office codes of the units. In either case, the seizure of an incoming trunk is effective to cause the seizure of an idle terminating sender at the combined terminating office through a sender link and, after the numerical digits have been registered in the terminating sender, to cause the association of an idle marker with such sender. The senders and markers at the terminating office being used for controlling the completion of a connection to any line terminating in either office unit over incoming and line-link frames common to both office units, it is therefore necessary to give the terminating sender and

marker information for terminating the connection in the proper office unit.

If a common group of incoming trunks is used, it is necessary to supply this information from the originating sender. This is accomplished during the transmission of reverive impulses from the terminating sender to the originating sender, which impulses cause the transfer of the numerical portion of the wanted line directory number to the registering equipment of the terminating sender and particularly during the transmission of impulses from the terminating sender which satisfy the incoming group registration in the originating sender. The originating sender is modified so that when the common group of trunks has been selected in accordance with the operation of the route relay of the originating marker in response to the dialing of the office code of one of the two office units, for example office A, the counting relays of the originating sender will satisfy the incoming group register of the sender after one to four reverive impulses have been received and that when the common group of trunks has been selected in accordance with the operation of the route relay of the originating marker in response to the dialing of the office code of the other of the two office units, for example of office B, the counting relays will satisfy the incoming group register only after from six to nine reverive impulses have been received. Since the number of reverive impulses transmitted from the terminating sender is recorded on the incoming group vertical of the cross-bar register thereof, this affords a means for informing the terminating sender as to the office unit destination of a call. This information is passed to the terminating marker over a special conductor extending through the marker connector to control a transfer relay in the marker, this relay being unoperated if the connection is to be terminated in office A and operated if the connection is to be terminated in office B. This relay is instrumental in connecting the marker to either one of the two number group frames allocated to the two office units so that from the selected number frame, the marker will receive the necessary information for controlling the incoming and line-link frames used commonly for both offices to select the desired line in the proper office unit.

If separate groups of incoming trunks are used, the previously indicated modification of the originating sender is not necessary since the group of incoming trunks seized identifies the destination of the call in either the A or B office units and

this identification is passed over the terminating sender link circuit to the terminating sender and thence to the marker to operate the transfer relay above mentioned.

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 the arrangement of equipment embodying the present invention;

Fig. 2 shows schematically subscribers' lines terminating in an originating office, line-link, district and office frames of cross-bar switches for extending connections from such lines, a sender link and control circuit for extending a connection from any district junctor to an idle sender and district and office frame connectors for associating the district and office frames with a marker;

Fig. 3 shows such portions of an originating sender, marker connector and marker as are necessary to an understanding of the invention;

Figs. 4 to 9, inclusive, disclose such portions of the equipment of the terminating office as are necessary to an understanding of the invention; Fig. 4 showing schematically a plurality of incoming juncctors, an incoming link and connector for associating any incoming junctor with an idle terminating sender, and relay equipment for transmitting an identification of the group of incoming trunks seized for the completion of a connection to the terminating sender; Fig. 5 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. 6 showing a portion of the terminating marker embodying the invention; Fig. 7 disclosing an incoming frame and one number group of each of the two office units served in common by the terminating sender and terminating marker; Fig. 8 showing additional relays and circuits of the terminating marker of Fig. 6 and Fig. 9 showing a plurality of line-link frames in each of two line choices and subscribers' lines terminating, respectively, in two office units; and

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

Referring first to Fig. 1, the operation of the system is briefly as follows: Upon the initiation of a call, for example on the subscriber's line 200, the line is extended by the primary and secondary line switches such as 201 and 202 of the line-link frame to an idle district junctor 203 and through the primary and secondary sender link switches 204 and 205 on the sender link and control frame to an idle originating sender 300. When the subscriber dials the wanted line designation, the digits of that designation are registered in the sender, an idle marker 302 is attached to the sender by the marker connector 301 and the marker in turn connects by means of a district frame connector 213 with the district link on the district frame in which the district junctor 203 appears. By means of an office frame connector 214, the marker selects and connects with an office link having access to an idle trunk extending to the wanted office. The marker then controls the establishment of the connection from the district junctor 203 to the idle outgoing trunk over primary and secondary switches such as 209 and 210 on the

district frame and over primary and secondary switches such as 211 and 212 on the office frame.

Upon the seizure of an idle trunk, such as 215, terminating in an incoming junctor 400 at the terminating office, assumed to serve two office units A and B, the incoming junctor becomes associated through the primary and secondary switches 404 and 405 of the terminating sender link frame with an idle terminating sender such as 500. Upon its seizure, the sender proceeds to transmit series of reverte impulses back over the established connection to the originating sender 300 to satisfy the originating sender with respect to the setting of its register which was set in response to dialing to register the numerical digits of the wanted line number. These impulses at the same time cause the setting of the cross-bar register of the terminating sender 500 to register the numerical digits of the called line designation for controlling the completion of the connection. The seizure of the terminating sender also causes the association of an idle terminating marker such as 600 therewith over the marker connector 501.

If it is assumed that both terminating office units A and B may be reached over the same group of incoming trunks including trunks 215 and 218, inclusive, the originating sender 300 will be arranged in such a manner that with a route relay of the originating marker 302 operated in accordance with the office code of the terminating office unit A, it will be satisfied during the transmission of the incoming group series of impulses after from one to four reverte impulses have been received, but that with a route relay of the originating marker operated in accordance with the office code of the terminating office unit B, it will be satisfied during the transmission of the incoming group series of impulses after from six to nine reverte impulses have been received. Accordingly, the cross-bar register of the terminating sender 500 will, due to its setting, determine in which office unit the call should be terminated and will transmit this information to the associated terminating marker to operate a transfer relay therein. If it be assumed that each terminating office unit may be reached over a separate group of incoming trunks, for example that office unit A may be reached over the group including trunks 215 and 217 and that office unit B may be reached over the group including trunks 216 and 218, then the originating sender 300 will not be arranged as just described but information with respect to the desired office unit will be transmitted to the terminating sender 500 in accordance with the incoming frame on which the selected group of incoming trunks terminate and this information will then be transmitted to the terminating marker to operate the transfer relay thereof.

With the information required for controlling the termination of the connection transferred to the terminating marker, the marker first selects the number group frame 740 or 790 of the A or B terminating office in accordance with the unoperated or operated condition of its transfer relay by the operation of either the number group frame connector 704 or 754 and then selects the portion of the selected number frame in which the wanted line terminates in accordance with the line number registered in the marker. The number group frame then transmits information to the marker to inform the marker with respect

to the line choice in which the wanted line terminates, the frame within the choice and the level on the frame and other information as to whether the wanted line is an individual line, a party line or one of a group of lines leading to a private branch exchange, and if the line is a party line whether the tip or ring substation on the line is desired. In accordance with this information the marker then proceeds to associate itself over an incoming frame connector 703 and a line-link frame connector 923 with the incoming frame in which the calling junctor terminates and with the proper line-link frame in which the wanted line terminates and to control the completion of the connection from the calling incoming junctor over the primary and secondary switches 700 and 701 of the incoming frame and over the primary and secondary switches 900 and 901 of the proper line-link frame to the wanted line, for example, to line 930 in office unit A or to line 980 in office unit B.

The circuits of the originating and terminating offices are in general similar to those fully disclosed and described in Patent 2,089,921, granted August 10, 1937 to W. W. Carpenter, the circuits of the terminating office being, however, modified in accordance with the circuits disclosed in the Patent No. 2,232,371 granted Feb. 18, 1941, to J. W. Dehn and O. Myers, but the circuits of both the originating and terminating offices have been further modified to embody the present invention.

It will first be assumed that a call is initiated on calling line 200 and that the calling subscriber desires a connection to line 930 terminating in office unit A of the combined terminating office. Upon the initiation of the call the calling line is connected to an idle district junctor such as 203 over an idle link such as 219 on the line-link frame by the operation of the primary line switch 201 and the secondary line switch 202 and the district junctor 203 is connected to an idle sender 300, portions of which are schematically disclosed in Fig. 3, by the operation of a primary switch 204 and a secondary switch 205 on the sender link and control frame. As soon as the calling line has been extended to the idle sender, the calling subscriber receives the usual dial tone and proceeds to dial the digits of the office frames are operated to complete the directory number of the wanted line 930 whereupon these digits are registered on the cross-bar register equipment of the sender. In order to simplify the disclosure, only such portions of the thousands vertical 303 and of the hundreds vertical 304 of the cross-bar register of the sender are disclosed as are necessary to illustrate the present invention.

Following the registration of the dialed code digits on the cross-bar register of the sender, an idle originating marker 302 is associated with the sender through the operation of the usual marker connector 301 and the office code digits are transferred to the incoming registers of the marker in the well-known manner resulting in the operation of a route relay in the marker. It will be assumed that since the office code dialed and registered in the marker indicates that the call is to be extended to line 930 terminating in the office unit A of the combined terminating office, route relay 305 is therefore operated. Under the control of the operated route relay, the marker now proceeds to associate itself over the district frame connector 213 with the district frame into which the calling district junctor 203

is incoming and to associate itself over the office frame connector 214 with the office frame in which the group of trunks extending to the wanted terminating office terminates. The marker then proceeds to test for idle links on the district frame to which the calling district junctor 203 has access, to test for idle office trunks, to test for idle links on the office frame and to test for idle outgoing trunks in the group extending to the desired terminating office. When such tests have been completed and it has been determined that a circuit path is available from the district junctor to an idle outgoing trunk, primary and secondary switches on the district and office frames are operated to complete the circuit path. For example, this circuit path may be extended from the district junctor 203 over the primary switch 209, link 206, and secondary switch 210 on the district frame, office trunk 207 over the primary switch 211, link 208 and secondary switch 212 on the office frame to the outgoing trunk 215.

It will be first assumed that lines terminating either the A or B office units may be reached over the same group of interoffice trunks, that is over any trunk of the group including trunks 215 to 218, inclusive, which terminate at the terminating office in the incoming juncctors 400 to 403. Trunk 215 having been selected as previously described, the incoming junctor 400 functions to associate itself with an idle terminating sender 500, portions of which are disclosed in Fig. 5, over a primary switch 404 and a secondary switch 405 of the incoming link and sender connector frame in the well-known manner. In part, this is accomplished by the operation of a group start relay 407, common to a group of incoming juncctors such as the group including juncctors 400 and 401, over a back contact of relay 406, relay 407 in turn causing the operation of a trunk group relay 408 for the trunk group in which the calling trunk 215 is located. A test is then made for an idle sender and subgroup relay 409 of a subgroup of terminating senders, in which an idle sender is located, is operated followed by relay 502 individual to the idle sender. The primary and secondary switches 404 and 405 of the sender connector frame are then operated to connect the calling junctor 400 with the selected idle sender.

Under the assumption that both office units may be reached over a common trunk group represented by the operated trunk group relay 408, the front contacts of relay 408 will both be connected to ground. The upper armature of relay 408 will be connected over conductor 410, the upper contact of relay 409 and conductor 412 to conductor 503 or over conductor 411, the next to upper contact of relay 409 and conductor 413 to conductor 504 dependent upon whether the number of the incoming frame in which the trunk group terminates is under or over ten and the lower armature of relay 408 will be connected over conductor 415, the inner contact of relay 409 to conductor 506. Thus with relay 502 of the terminating sender 500 operated, either relay 507 or 508 will be operated over conductor 503 or conductor 504 to indicate to the sender whether the number of the incoming frame is under or over ten and relay 509 will be operated over conductor 506 to indicate to the sender that a trunk of a group common to two office units has been seized. These relays, if operated, lock under the control of off-normal relay 511 which operated when the sender was seized.

Both relays 507 and 508 and both relays 509 and 510 should not be simultaneously operated and therefore with relay 509 operated and either relay 507 or 508 operated, a circuit is established for relay 512 extending from battery through the winding of relay 512, upper front contact of relay 509, back contact of relay 510, back contact of either relay 507 or 508 dependent upon which is unoperated, thence to ground. Relay 512 operates, locks under the control of relay 511 and conditions the sender for operation. As fully disclosed in Patent 2,089,921 to Carpenter, hereinbefore referred to, the terminating sender proceeds to register the incoming frame information transmitted from the incoming link, a portion of which has been indicated by the operated condition of either relay 507 or 508 and to transmit series of revertive impulses to the originating sender 300 of Fig. 3 to satisfy the sender with respect to the setting of the numerical digit portion of its cross-bar register. The circuit over which these impulses are transmitted extends from the terminating sender 500 over the tip and ring fundamental circuit conductors extending over contacts of switches 204, 205, 209, 210, 211, 212, 404 and 405, the tip conductor 220 of fundamental circuit at the originating sender 300 being looped to the ring conductor 221 over a normal contact of relay 307, a front contact of relay 308, a back contact of relay 309 through the windings of overflow relay 310 and stepping relay 311, a back contact of relay 312 and a front contact of relay 315. Stepping relay 311 operates in response to each impulse transmitted in each series of revertive impulses.

It has been assumed that the calling subscriber dialed the directory number of subscriber's line 930 terminating in office A and that route relay 305 of the originating marker 302 has been operated. Under this condition, relay 306 is operated and therefore when the terminating sender 500 transmits the incoming group series of impulses to satisfy the incoming group setting of the register of sender 300 as determined jointly by the thousands and hundreds digits registered on the thousands vertical 303 and the hundreds vertical 304 of the register, the fundamental circuit will be opened by the operation of relay 312 after from one to four impulses have been received and counted by the counting relays of the sender. If it be assumed that the thousands digit registered was 0 and the hundreds digit was 4 and that, therefore, register cross-points 316 and 317 are closed, then on the first operation of stepping relay 311 in response to the first impulse of the incoming group series, with steering relays 318 and 319 operated, a circuit is established from ground over the upper back contact of relay 320, contacts of stepping relay 311, lower back contact of relay 320, front contact of relay 321, back contact of counting relay 333, back contact of counting relay 323, contact of relay 319, cross-point contacts 317, the left cross-point contacts 316, front contact of relay 315, front contact of relay 318, front contact of relay 306, winding of counting relay 313 to battery. Relay 313 operates and locks in series with counting relays 312 and 314 and over its own front contact to ground at the right front contact of relay 308, but relays 312 and 314 do not operate in this locking circuit since their windings are shunted so long as stepping relay 311 remains operated. When relay 311 releases, however, relays 312 and 314 operate. Relay 312 upon operating opens the fundamental circuit to terminate the impulse

series and prepares the circuits of the sender 300 for controlling the setting of the register of the terminating sender in accordance with the setting of its register for final brush selection. Since the originating sender was satisfied after the receipt of one revertive impulse in the incoming group series, the terminating sender 500 has functioned to close cross-point contacts 313 of the incoming group vertical of its cross-bar register in the manner fully set forth in the patent to Carpenter above referred to.

Had the calling subscriber dialed the directory number of subscriber's line 980, terminating in office unit B, route relay 334 would have been operated in accordance with the office code digits dialed. In this case, relay 306 would not be operated and assuming that the numerical digits dialed were the same as dialed to reach the subscriber's line 930, cross-point contacts 316 of the thousands vertical 303 and cross-point contacts 317 of the hundreds vertical would be closed. When now the terminating sender 500 transmits revertive impulses to cause the selection of a set of cross-point contacts in its incoming group vertical, as determined by the joint closure of cross-point contacts 316 and 317 of the originating sender, relay 311 upon operating in response to the first impulse closes a circuit from ground at the upper back contact of relay 320, contacts of relay 311, lower back contact of relay 320, front contact of relay 321, back contact of counting relay 333, back contact of counting relay 323, contact of steering relay 319, cross-point contacts 317, left cross-point contacts 316, right contact of relay 315, contact of steering relay 318, back contact of relay 306, winding of counting relay 332 to battery. Relay 332 operates and locks through the winding of counting relay 333 and over its own front contact to ground at the front contact of relay 308, but relay 333 does not operate in this locking circuit since its winding is shunted so long as relay 311 remains operated. As soon as the first revertive impulse ceases, relay 311 releases and counting relay 333 thereupon operates.

When relay 311 operates in response to the second revertive impulse, the circuit controlled thereby is extended over the front contact of counting relay 333 and the back contact of counting relay 331 to battery through the winding of counting relay 330. Relay 330 thereupon operates and locks through the winding of relay 331 and its own front contact to ground at the right back contact of relay 309, but relay 331 does not operate in this locking circuit until relay 311 releases at the end of the second revertive impulse. In a similar manner in response to the next three revertive impulses, counting relays 328, 329, 326, 327, 324 and 325 operate and lock. When relay 311 again operates in response to the sixth revertive impulse, with counting relay 325 operated, a circuit is established over the front contact of relay 325, the back contact of relay 335, to battery through the winding of counting relay 313 which thereupon operates and locks in series with relays 312 and 314. When relay 311 releases upon the termination of this impulse, counting relays 312 and 314 operate in the locking circuit of relay 313, relay 312 functioning to terminate the transmission of further impulses in the incoming group series and relay 314 functioning to prepare the sender 300 for receiving impulses of the final brush series. Since the sender 300 was satisfied after

the receipt of six reverive impulses in the incoming group series, the terminating sender 500 has functioned to close the cross-point contacts 514 of the incoming group vertical of its cross-bar register. It will thus be seen that for a call to a line terminating in office unit B, the originating sender has required the terminating sender to transmit five additional impulses in the incoming group series and therefore while the closure of cross-point contacts 513 or 514 at the terminating sender will register the same incoming group information, the closure of cross-point contacts 513 will indicate that a line terminating in office unit A is desired whereas the closure of cross-point contacts 514 will indicate that a line in office unit B is desired.

When the remainder of the information concerning the numerical identification of the wanted line has been transferred from the originating sender 300 and registered in the terminating sender 500, a signal is transmitted to the originating sender 300 to cause its release and the terminating sender is associated with an idle terminating marker over the marker connector 501. It will be assumed that the marker 600, such portions of which as are essential to an understanding of the invention being disclosed in Figs. 6 and 8, is available and becomes connected with the sender 500. Following the connection of the marker with the sender, a circuit is established for signaling the marker as to whether the wanted line terminates in office unit A or office unit B served by that marker. If, as assumed, both office units are reached over a common group of trunks and relay 509 has been operated as previously described, then if the cross-point contacts 513 of the incoming group vertical of sender 500 have been closed indicating a call for a line terminating in office unit A, a circuit is established from battery through the winding of relay 601, conductor 602, contacts of marker connector 501, lower contacts of relay 509, cross-point contacts 513, to the checking lead 515 but relay 601 does not operate over this circuit and consequently relay 603 is operable over the back contact of relay 601. Had the cross-point contacts 514 been closed, then the circuit just traced for relay 601 would have been completed over conductor 516 to ground and relay 601 would have operated to cause the operation of relay 604 over its front contact. It is to be noted that if the sender 500 is allocated to serve trunk groups over which two office units may be reached, the arrow connections indicated at the cross-point contacts of the incoming group register of sender 500 would be united.

Upon the association of the sender with the marker, a plurality of other control circuits are established over which the digits of the registered wanted line designation are transferred from the sender to the marker and recorded on groups of register relays represented by thousands relay 605, hundreds relay 606, tens relay 607, and units relay 608. The hundreds relay 606 indicates whether the hundreds digit is greater or less than 5 by operating relay 609 for digits greater than 5 and indicates the position of the digit in either series by operating one of five relays such as relay 610. The thousands relay 605 marks one of ten conductors, such as conductor 611, which is extended to either relay 612 or 613 according as relay 609 is or is not operated and relay 603 is operated or which is extended to either relay 614 or 615 according as relay 609

is or is not operated and relay 604 is operated. Therefore, the joint operation of the thousands and hundreds register relays identifies one of forty groups of five hundred lines each by operating one of a set of twenty relays such as 612 and 613 allocated for calls to office unit A or by operating one of a set of twenty relays such as 614 and 615 allocated for calls to office unit B dependent upon whether relay 603 or relay 604 is operated.

The tens register represented by relay 607 discriminates between even and odd digits by operating relay 616 for odd digits and identifies blocks of twenty numbers by operating one of a set of five relays such as 617 which in turn operate relays such as 618. The units register relay 608 grounds one of ten conductors which are extended to twenty conductors according to the operated or non-operated condition of relay 616.

The joint operation of relay 610 and either relay 612 or 613 selects a number group frame in the office unit A by completing a circuit for a marker preference relay such as 705 or 706. Similarly, the joint operation of relay 610 and relay 614 or 615 selects a number group frame in the office unit B by completing a circuit for a marker preference relay such as 755 or 756. 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. It will be assumed that the wanted number terminals are on number group frame 707 allocated to the office unit A and that preference relay 705 is operated as soon as the frame is idle, in turn operating a multicontact relay 708 which closes the necessary circuits between the marker and the number group frame. With relay 708 operated, the hundred block relay 709 is operated under the control of relays 610 and 613, there being one relay 709 for each one hundred numbers included in the number group. With relay 709 operated, twenty block relay 710 is operated under the control of relays 618 and 709, there being one such relay for each twenty numbers in the number group frame.

With relays 708, 709 and 710 operated, twenty sets of three terminals each on the number frame 707, such as 711 to 713, and 714 to 716 are marked by connecting them to equipment in the marker. For example, terminal 711 is connected over front contacts of relays 710 and 708 and the back contacts of relay 619 to the winding of busy test relay 621, while terminal 714 is similarly connected over a back contact of relay 620 to the winding of busy test relay 622. The corresponding terminals on the other eighteen sets are also connected to intermediate relays in the set of twenty busy test relays. Terminals 712 and 715 are connected to armatures of selecting relays 619 and 620 respectively and the corresponding terminals of the remaining sets are connected to armatures of intermediate relays of this group and terminals 713 and 716 are connected over back contacts of relays 619 and 620 to the windings of relays 623 and 624 which become effective only in the 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 the class of service to which the line is entitled. Therefore there is provided

in the marker a group of line choice relays 800, 801, 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 802 to 805 is provided each pair of relays 802 and 803 or 804 and 805 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 three types of service, the line choice relays 800, 801, 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 708, 731, 758 and 781 and over contacts of these relays to sets of terminal strips of the number group frames. The operating conductors 806, 807 and 808 for relay 800 extend to terminal strips 717, 718 and 719 and similarly the operating conductors 809 to 812 for the frame level relays 802 and 803 are connected over contacts of relay 708 to terminal strips 720 to 723, it being assumed that connector relay 708 is operated.

The subscriber's line 930 of office unit A where it enters the office is connected to a distributing frame 903 from which the line is extended to one of the primary line switches 901 in accordance with the traffic requirements. The line itself is connected to the line terminals 904 and 905 while individual to the line terminals 904 and 905 are the sleeve or busy terminal 906 and the message register terminal 907.

At the number frame, assuming that the set of number terminals 711, 712 and 713 represent the number assigned to line 930, terminal 711 will be cross-connected over jumper 724 to terminal 906 individual to the position in the primary switch 901 assigned to the line 930. According to the present disclosure, line 930 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 712 is connected over jumper 725 to strip 720 and terminal 713 is connected over jumper 726 to strip 717.

When the twenty block relay 710 operates as above described, the sleeve test circuit for line 930 extends from battery through the winding of relay 621, back contact of relay 619 over front contacts of relays 708 and 710, terminal 711, jumper 724, to the sleeve terminal 906 individual to the line. If the line is busy relay 621 operates from the busy ground on the sleeve of the line. At the same time battery through the winding of relay 623 is connected over the back contact of relay 619, over contacts of relays 708 and 710, terminal 713, thence over jumper 726, strip 717, conductor 806, left winding of the No. 0 line choice relay 800 to battery. Therefore relay 623 does not operate. After an interval to permit the busy test relays 621, 622, etc., to operate, ground is connected under the control of the units register to conductor 625 thereby operating relay 619 provided relay 621 is not operated. With relay 619 operated, ground is connected to conductors 626 and 627. Conductor 626 extends to terminal 713, thence over jumper 726, strip 717, conductor 806, left winding of relay 800 to battery. Relay 800 will operate over this circuit to identify the No. 0 line choice and

extends its operating ground to the winding of relay 813 to indicate that the wanted line is to be handled as an individual line. Conductor 627 extends to terminal 712, thence over jumper 725 to strip 720, conductor 809, left winding of relay 802 to battery. Relay 802 upon operating identifies the No. 0 level and extends its operating ground over its inner left contact to the winding of relay 814 to identify the No. 0 frame. It may be noted that relays 814 to 817 represent the four frames of a choice and are operated from the corresponding energizing circuits for each pair of frame level relays.

With relay 800 operated, the No. 0 line choice is selected by operating the marker preference relay 908 individual to the marker shown in the No. 0 line choice connector. The marker preference relay operates the multicontact relay 909 which extends all of the control circuits from the marker through to the choice. The frame relay 814 closes a circuit from ground through the winding of relay 818, contacts of relay 814 to the winding of relay 910, 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 818 operates if the frame equipment is idle and connects ground to the outer left contacts of the level relays 802, 804, etc., and since relay 802 is assumed to be operated, operates horizontal level relay 911. Relay 911 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 Patent No. 2,232,371, granted Feb. 18, 1941 to J. W. Dehn et al. The hold magnet 912 of this line is operated over the front contact of relay 619 after an idle channel has been selected.

It will now be assumed that the call was for subscriber's line 980 in office unit B and that therefore through the operation of relays 601 and 604 and the same setting of the register relays as previously considered, the number frame 757 is selected by the operation of the frame connector relay 758 and the hundred block relay 759 and the twenty block relay 760 are also operated. It will further be assumed that terminals 761, 762 and 763 are connected in the manner previously described in connection with terminals 711, 712 and 713, that is terminal 761 is connected over front contacts of relays 760 and 758 and the back contact of relay 619 to the winding of busy test relay 621, terminal 762 is connected to an armature of selecting relay 619 and terminal 763 is connected over a back contact of relay 619 to the winding of relay 623. It will be further assumed that subscriber's line 980 where it enters the office unit B is connected to a distributing frame 953 from which the line is extended to one of the primary line switches 951 in accordance with traffic requirements. The line itself is connected to the line terminals 954 and 955 while individual to the line terminals 954 and 955 are the sleeve or busy terminal 956 and the message register terminal 957.

At the number frame, assuming that the set of number terminals 761, 762 and 763 represent the number assigned to the line 980, terminal 761 will be cross-connected over jumper 774 to terminal 956 individual to the position in the primary switch 951 assigned to line 980. According to the present disclosure line 980 appears in the No. 0 level of the No. 0 frame in the No. 9 choice and is an individual message

rate line. Therefore terminal 762 is connected over jumper 775 to strip 770 and terminal 763 is connected over jumper 776 to strip 780.

When the twenty block relay 760 operates as above described, the sleeve test circuit for line 980 extends from battery through the winding of relay 621, back contact of relay 619 over front contacts of relays 758 and 760, terminal 761, jumper 774, to the sleeve terminal 956 individual to the line. If the line is busy, relay 621 operates from the busy ground over the sleeve of the line. At the same time battery through the winding of relay 623 is connected over the back contact of relay 619 over contacts of relays 758 and 760 to terminal 763, thence over jumper 776, strip 780, conductor 819, left winding of the No. 9 line choice relay 801 to battery. Relay 623 does not operate in this circuit. After an interval to permit the busy test relays 621, 622, etc., to operate, ground is connected under the control of the units register to conductor 625, thereby operating relay 619 provided relay 621 is not operated. With relay 619 operated, ground is connected to conductors 626 and 627, conductor 626 extending to terminal 763, thence over jumper 776 to strip 780 and conductor 819 through the left winding of relay 801 to battery. The operation of relay 801 over this circuit identifies the No. 9 line choice. Relay 801 extends its operating ground to the winding of relay 813 to indicate that the wanted line is to be handled as an individual line. Conductor 627 extends to terminal 762, thence over jumper 775 to strip 770, thence over conductor 809, left winding of relay 802 to battery. Relay 802 upon operating identifies the No. 0 level and extends its operating ground over its inner left contact to the winding of relay 814 to identify the No. 0 frame.

With relay 801 operated the No. 9 line choice is selected by operating the marker preference relay 958 individual to the marker shown in the No. 9 line choice connector. The marker preference relay operates the multicontact relay 959 which extends all of the control circuits from the marker through to the choice. The frame relay 814 closes a circuit from ground through the winding of relay 818, contacts of relay 814 to the winding of relay 960, 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 818 operates if the frame equipment is idle and connects ground to the outer left contacts of the level relays 802, 804, etc., and since relay 802 is assumed to be operated, operates horizontal level relay 961. Relay 961 connects the operating circuits for the select magnets, corresponding to the ten junctors which serve the wanted line, through to the marker where one will be selected. The hold magnet 962 of line 980 is operated over the front contact of relay 619 after an idle channel has been selected.

It will now be assumed that the office unit A and the office unit B are reached from the originating office over separate trunk groups and that office unit A is reached over a trunk group including trunks 215 and 217 terminating in incoming junctors 400 and 401 and that office unit B is reached over a trunk group including trunks 216 and 218 terminating in incoming junctors 402 and 403. It will be noted that when a trunk of the first group is calling, the group start relay 407 is operated resulting in the operation of trunk group relay 408 and that when a trunk of

the second group is calling the group start relay 417 is operated resulting in the operation of trunk group relay 418. In this case the lower front contacts of relays 408 and 418 are patched to ground, the lower armature of relay 408 is patched over conductor 415 to the inner armature of relay 409, the lower armature of relay 418 is patched over conductor 414 to the next to inner armature of relay 409, the inner front contact of relay 409 is patched over conductor 419 to conductor 504 and the next to inner front contact of relay 409 is patched over conductor 420 to conductor 503. Thus when the sender 500 has been seized and relay 502 thereof has operated, a circuit will be completed over conductor 503 for relay 507 if the call is incoming over the trunk group 215, 217 for a line terminating in office unit A or a circuit will be completed over conductor 504 for relay 508 if the call is incoming over the trunk group 216, 218 for a line terminating in office unit B. In terminating offices equipped in this manner to identify the called office unit by the individual trunk group identification, the upper back contacts of relays 507 and 508 would be wired directly to the winding of relay 512, the ground connections to the upper cross-points of the incoming group register of the sender would not be wired and the arrow connections in the marker 600 would be connected at the point indicated by number 628.

If now a call is incoming for a line in office unit A and relay 507 is therefore operated, a circuit is established as soon as the sender 500 has been connected to the marker 600 over the marker connector 501, from battery through the winding of relay 601 in the marker, over conductor 602 patched at 628 to conductor 629, contacts of marker connector 501, upper front contact of relay 507 to checking lead 517. Relay 601 does not, however, operate and consequently relay 603 operates to cause the selection of the number group of the office unit A as previously described. If, however, the call is incoming for a line in office unit B and relay 508 is therefore operated, the circuit just traced for relay 601 extends to direct ground at the upper front contact of relay 508 and relays 601 and 603 therefore operate to cause the selection of a number group of the office unit B as previously described.

From the foregoing it will be apparent that it is possible in a simple manner to utilize the same terminating equipment for terminating calls in either one of two office units located in the same office building, thereby securing a much more efficient use of such equipment.

What is claimed is:

1. In a telephone system a first office, other offices, switching mechanism in said first office for extending connections to said other offices, a sender in said first office having registers for registering the office code and numerical designations of wanted lines, means controlled in accordance with the office code registrations for setting said switching mechanism to extend a connection to said other offices, switching mechanism in said other offices, a sender common to said other offices having registers for registering the numerical designations of wanted lines in accordance with the setting of the numerical registers of said first sender, discriminating means in said latter sender operable in accordance with the office code registered in said first sender for determining in which of said other

offices a call is to be terminated, and means controlled in accordance with the numerical registrations established in said latter sender and said discriminating means for operating said latter switching mechanism to complete a connection to a wanted line terminating in any of said other offices.

2. In a telephone exchange system, a first office, other offices, groups of interoffice trunks extending from said first office to said other offices, switching mechanism in said first office, a sender in said first office having registers for registering the office code and numerical designations of wanted lines, means controlled in accordance with the office code registrations for setting said switching mechanism to extend a connection to an idle trunk in any of said groups of trunks, switching mechanism in said other offices, a sender common to said other offices having registers for registering the numerical designations of wanted lines in accordance with the setting of the numerical registers of said first sender, discriminating means in said latter sender operable in accordance with the group of trunks in which the seized trunk is located for determining in which of said other offices a call is to be terminated, and means controlled in accordance with the numerical registrations established in said latter sender and said discriminating means for operating said latter switching mechanism to complete a connection to a wanted line terminating in any of said other offices.

3. In a telephone exchange system, a first office, other offices, groups of interoffice trunks extending from said first office to said other offices, switching mechanism in said first office, a sender in said first office having registers for registering the office code and numerical designations of wanted lines, means controlled in accordance with the office code registrations for setting said switching mechanism to extend a connection to an idle trunk in any of said groups of trunks, switching mechanism in said other offices, a sender common to said other offices having registers for registering the numerical designations of wanted lines in accordance with the setting of the numerical registers of said first sender, means for associating any incoming trunk with said latter sender, relays in said latter sender selectively operable from said associating means in accordance with the group of trunks in which the seized trunk is located for determining in which of said other offices a call is to be terminated, and means controlled in accordance with the numerical registrations established in said latter sender and the operated one of said relays for operating said latter switching mechanism to complete a connection to a wanted line terminating in any of said other offices.

4. In a telephone exchange system, a first office, other offices, groups of interoffice trunks extending from said first office to said other offices, switching mechanism in said first office, a sender in said first office having registers for registering the office code and numerical designations of wanted lines, means controlled in accordance with the office code registrations for setting said switching mechanism to extend a connection to an idle trunk in any of said groups of trunks, switching mechanism in said other offices, a sender common to said other offices having registers for registering the numerical designations of wanted lines in accordance with the setting of the numerical registers of said

first sender, means for associating any incoming trunk with said latter sender, relays in said latter sender selectively operable from said associating means in accordance with the group of trunks in which the seized trunk is located for determining in which of said other offices a call is to be terminated, a marker associable with said latter sender, transfer means in said marker selectively controlled by said sender relays for determining to which of said other offices said marker shall direct a call, and means in said marker controlled in accordance with the numerical registrations established in said latter sender for operating said latter switching mechanism to complete a connection to a wanted line terminating in the office determined by said transfer means.

5. In a telephone exchange system, a first office, other offices, a common group of trunks extending from said first office to said other offices, switching mechanism in said first office, a sender in said first office having registers for registering the office code and numerical designations of wanted lines, means controlled in accordance with the office code registrations for setting said switching mechanism to extend a connection to an idle trunk of said group, switching mechanism in said other offices, a sender common to said other offices having registers for registering the numerical designations of wanted lines in accordance with the setting of the numerical registers of said first sender, means controlled in accordance with the office code registrations of said first sender for establishing a discriminating setting of one of the registers of said latter sender for determining in which of said other offices a call is to be terminated, and means controlled in accordance with the numerical registrations established in said latter sender and the discriminating setting of said one register for operating said latter switching mechanism to complete a connection to a wanted line in any of said other offices.

6. In a telephone exchange system, a first office, a second office, a third office, a common group of trunks extending from said first office to said other offices, switching mechanism in said first office, a sender in said first office having registers for registering the office code and numerical designations of wanted lines, means controlled in accordance with the office code registrations of either said second or third offices for setting said switching mechanism to extend a connection to an idle trunk of said group, a sender common to said second and third offices having registers, means for transmitting series of reverive impulses from said latter sender to said first sender whereby the registers of said latter sender are set to register the numerical designations of wanted lines in accordance with the setting of the numerical registers of said first sender, means in said first sender operable in accordance with the office code registrations of said third office to cause the addition of five impulses to one of said series of reverive impulses to establish a discriminatory setting of one of the registers of said latter sender for determining that a call is to be terminated in said third office, and means controlled in accordance with the numerical registrations established in said latter sender and the discriminating setting of said one register for operating said latter switching mechanism to complete a connection to a wanted line in either said second or third office.

7. In a telephone exchange system, a first office, other offices, a common group of trunks extending from said first office to said other offices, switching mechanism in said first office, a sender in said first office having registers for registering the office code and numerical designations of wanted lines, means controlled in accordance with the office code registrations for setting said switching mechanism to extend a connection to an idle trunk of said group, switching mechanism in said other offices, a sender common to said other offices having registers for registering the numerical designations of wanted lines in accordance with the setting of the numerical registers of said first sender, means controlled in accordance with the office code registrations of said first sender for establishing a discriminating setting of one of the registers of said latter sender for determining in which of said offices a call is to be terminated, a marker associable with said latter sender, transfer means in said marked selectably controlled in accordance with the discriminating setting of said one register for determining to which of said other offices said marker shall direct a call and means in said marker controlled in accordance with the numerical registrations established in said latter sender to complete a connection to a wanted line terminating in the office determined by said transfer means.

8. In a telephone exchange system, a first office, other offices, switching mechanism in said first office for extending connections to said other offices, a sender in said first office having registers for registering the office code and numerical designations of wanted lines, means controlled in accordance with the office code registrations for setting said switching mechanism to extend a connection to said other offices, switching mechanism in said other offices common thereto, a sender common to said other offices having registers for registering the numerical designations of wanted lines in accordance with the setting of the numerical registers of said first sender, discriminating means in said latter sender operable in accordance with the office code designations registered in said first sender for determining in which of said other offices a call is to be terminated, and means common to said other offices controlled in accordance with the numerical registrations established in said latter sender and said discriminating means for operating said common switching mechanism to complete a connection to a wanted line in any of said other offices.

9. In a telephone exchange system, a first of-

fice, other offices, groups of inter office trunks extending from said first office to said other offices, switching mechanism in said first office, a sender in said first office having registers for registering the office code and numerical designations of wanted lines, means controlled in accordance with the office code registration for setting said switching mechanism to extend a connection to an idle trunk in any of said groups of trunks, switching mechanism in said other offices common thereto, a sender common to said other offices having registers for registering the numerical designations of wanted lines in accordance with the setting of the numerical registers of said first sender, discriminating means in said latter sender operable in accordance with the group of trunks in which the seized trunk is located for determining in which of said other offices the call is to be terminated, and means controlled in accordance with the numerical registrations established in said latter sender and said discriminating means for operating said common switching mechanism to complete a connection to a wanted line terminating in any of said other offices.

10. In a telephone exchange system, a first office, other offices, means for establishing a connection from said first office to said other offices, a plurality of subscribers' lines terminating in each of said other offices, a plurality of switches common to said other offices in which said lines appear, control equipment common to said lines and to said switches, a cross-connecting rack allocated to each of said other offices, means to register the directory number of any line and to indicate the particular one of said offices in which the wanted line terminates in said control equipment, means responsive to said office indication to select the cross-connecting rack of the desired office, means responsive to the directory number registration to select a set of terminals on said selected rack individual to said number, means to individualize said set of terminals to a subscriber's line, means including said set of terminals to transmit to said control equipment information characteristic of the nature and location of the wanted line, and means responsive to the transmission of said information to connect said control equipment with the switch in which said line appears and for controlling the completion of the connection to said line.

RALPH E. HERSEY.
OTTMAR H. KOPP.
OSCAR MYERS.
JAMES B. NEWSOM.