

May 21, 1940.

W. W. CARPENTER ET AL

2,201,573

TELEPHONE SYSTEM

Filed Nov. 16, 1939

4 Sheets-Sheet 1

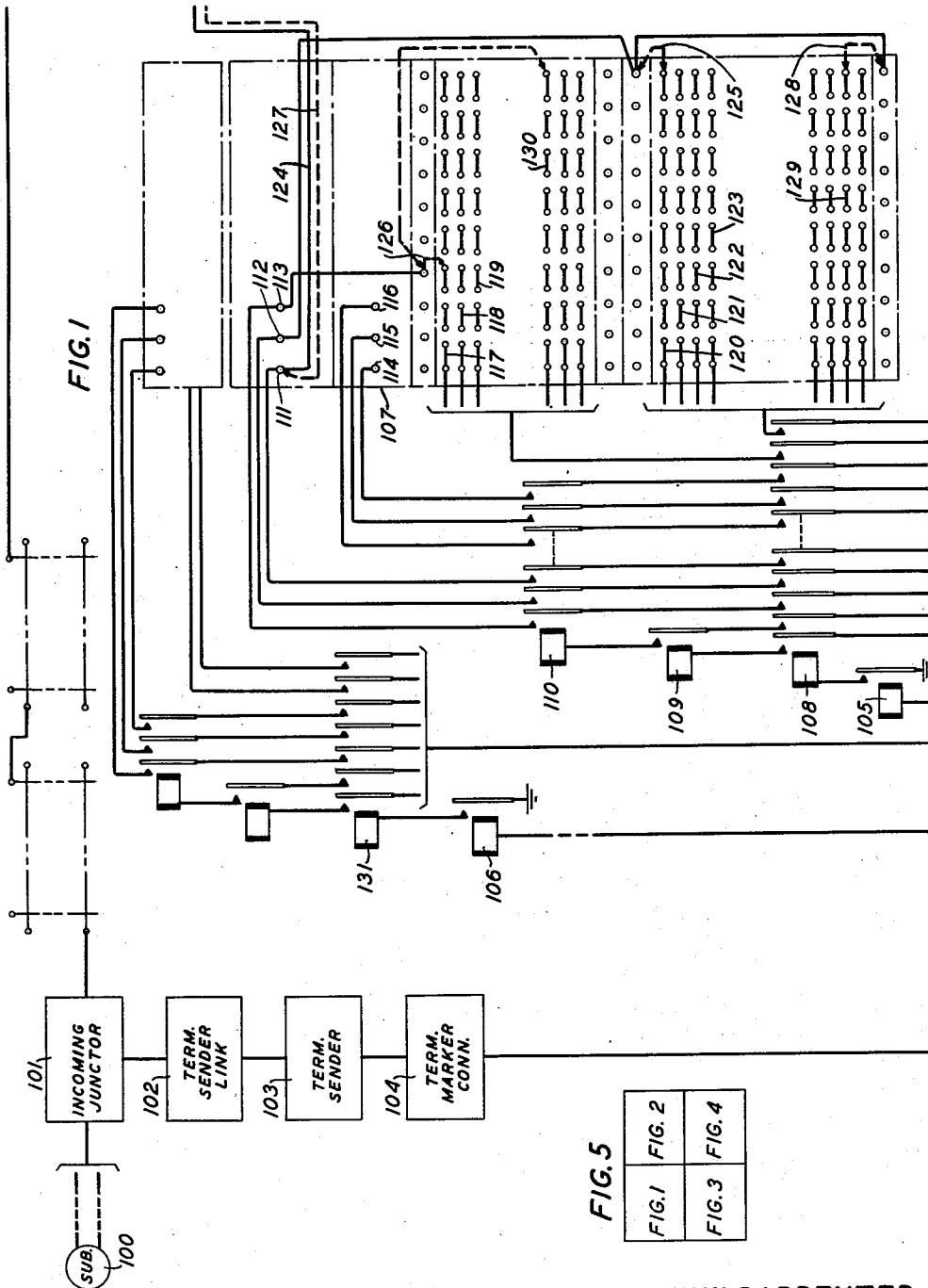


FIG. 5

FIG. 1	FIG. 2	FIG. 4
FIG. 3		

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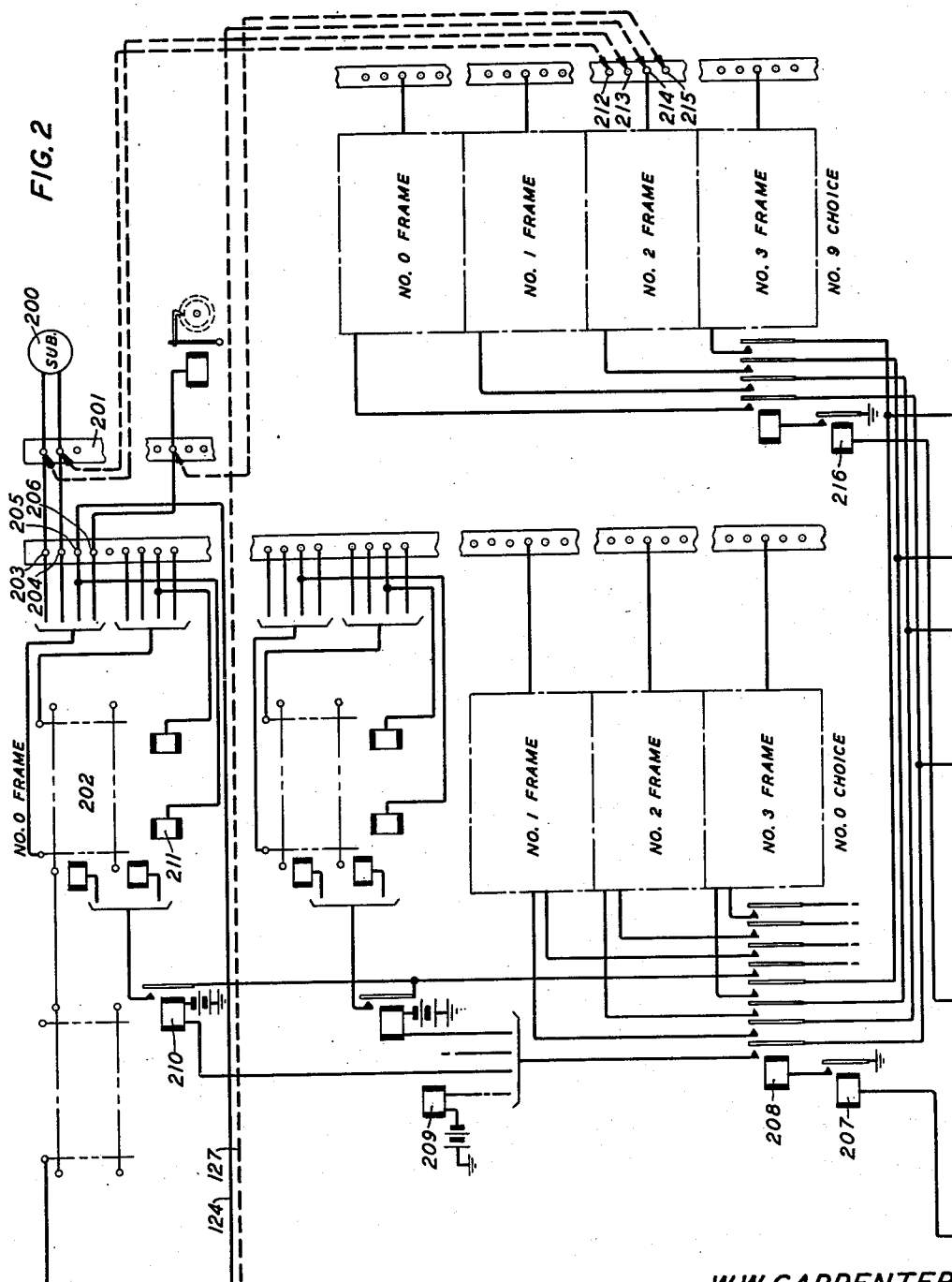
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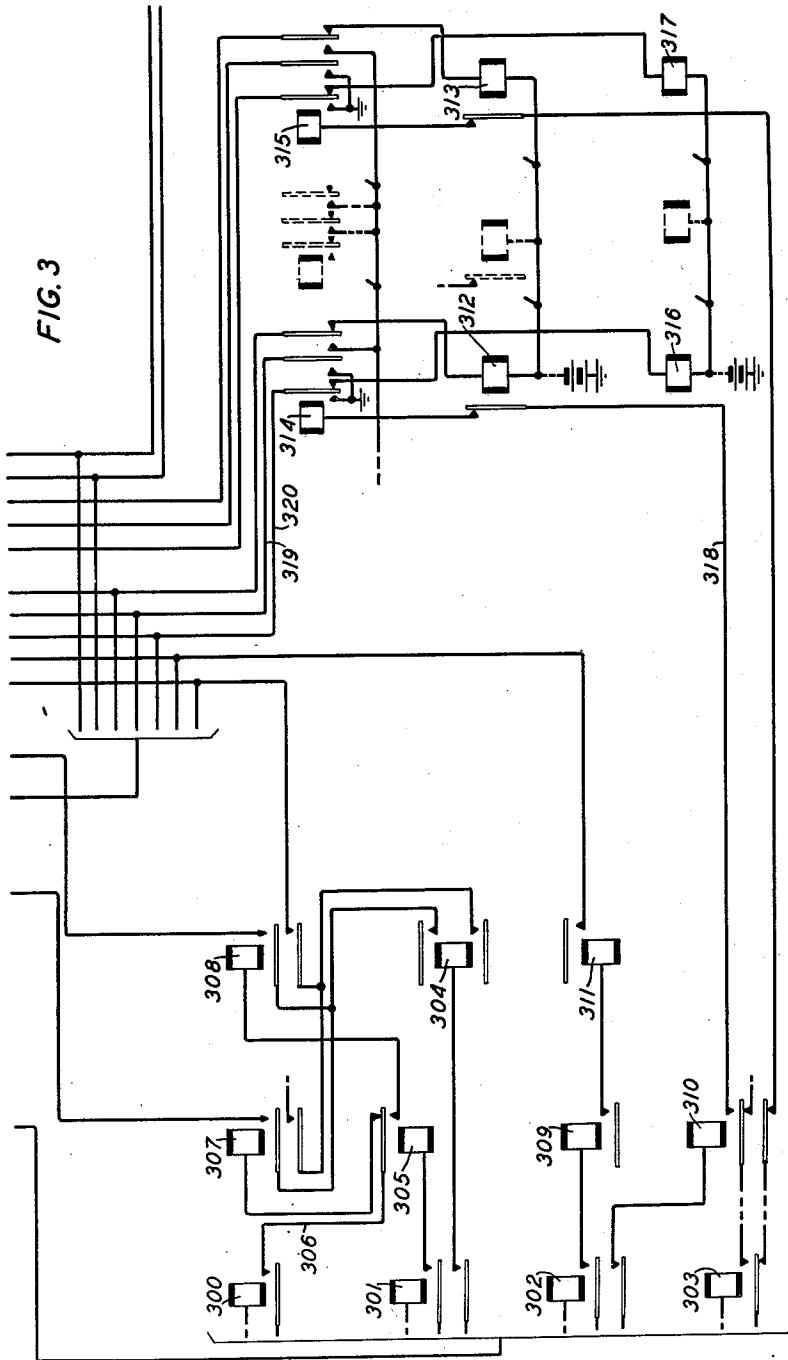
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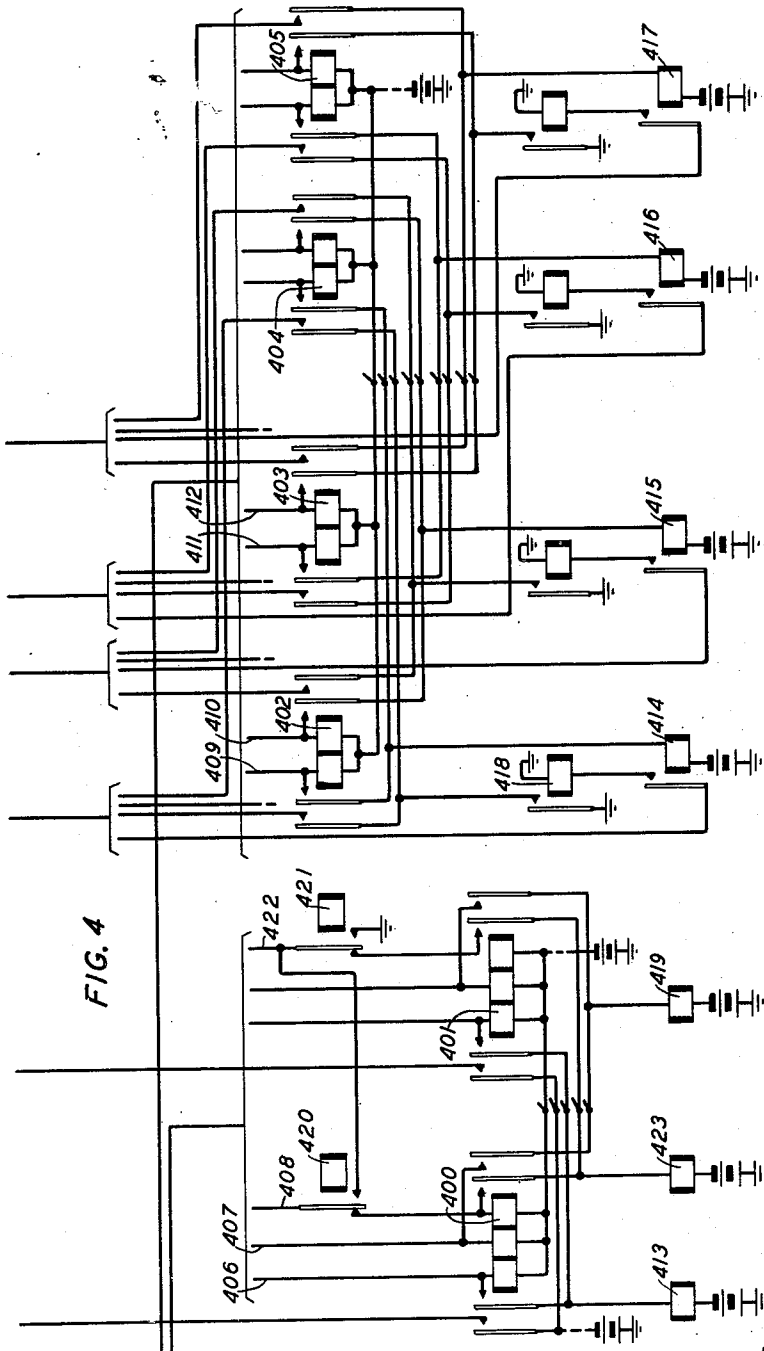


FIG. 4

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UNITED STATES PATENT OFFICE

2,201,573

TELEPHONE SYSTEM

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Application November 16, 1938, Serial No. 240,698

5 Claims. (Cl. 179—18)

This invention relates to telephone systems and has for its object increased flexibility in the determination of numbers and locations for subscribers' lines.

As disclosed in the cross-bar system of the prior art, a certain degree of flexibility was obtained by dividing the subscribers' lines into large groups, in accordance with the switching equipment by which the lines were served, within which the lines might be transferred freely by change of cross-connections without change in number and between which the lines might be interchanged without change of number providing a sufficient number of lines were transferred at the same time.

In accordance with the present invention, complete independence of the line number and the line location in the switching equipment is attained. To this end there is provided a set of terminals for each line entering the office, sets of incoming terminals for the primary line switches and a set of terminals for each line number to be used in the office, and means are provided for individualizing one of the sets of number terminals to one of said line terminals and switch incoming terminals, with means for varying such individualization. That is, the number assigned to a line may be altered without altering the connection between the line terminals and switch terminals or the line may be connected to a different set of switch terminals without altering the number assigned to it.

The invention will be more clearly understood from a consideration of the following description in connection with the drawings in which:

Fig. 1 shows the equipment incoming to an office and a number group frame and connector;

Fig. 2 shows parts of two line choices;

Fig. 3 shows the registering equipment of the marker; and

Fig. 4 shows additional equipment in the marker.

The present disclosure is a skeletonized showing of the terminating equipment of an office. A more complete showing of the marker for controlling such equipment is to be found in the copending application of J. W. Dehn et al., Serial No. 240,718, filed concurrently herewith.

In the cross-bar system, each switch unit comprises one hundred contact elements which provide junctions between ten incoming elements and ten outgoing elements. The switches which serve the subscribers' lines are known as primary line switches and one to seven of these switches are arranged in a horizontal group known as a

level, ten levels of which are arranged vertically to constitute a frame, four frames comprising a line choice. One subscriber's line is connected to each of the incoming elements and, therefore, a choice may serve from 400 to 2800 lines, the number of switches included in a level and, therefore, the number of lines in that level being determined by traffic conditions.

In the establishment of terminating connections, a terminating sender and terminating marker are employed, the sender receiving the line designation from the originating equipment and transferring it to the marker. From this registration the marker first selects a set of terminals representing a group of twenty line numbers within which the wanted line number lies. By this selection the marker determines the number group frame on which the terminals of the wanted number are mounted and by means of the number group connector selects a number frame and operates a hundred-block relay and a twenty-block relay on that frame. With the twenty-block relay operated, a set of three circuits for each of the twenty numbers is extended from the marker to twenty sets of three terminals each on the number frame, individual to the twenty numbers included in the twenty block.

For the establishment of a connection to the wanted line it is necessary that the marker know the line choice within which the line is located, the frame within the choice and the level on the frame. It is also necessary to know 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 a party line, whether it is a tip or ring party. Furthermore, the marker must know whether the wanted line is busy or idle. Therefore, there is provided on the number frame a block of control terminal strips representing line switch levels. Forty terminal strips are provided, one for each level of the four frames in any one choice. A second block of terminals combines the identification of the line choice and the class of the line, there being ten sets of three terminal strips each, to care for a maximum of ten line choices. One strip of each set represents an individual line, the ring party line or the last line of a private branch exchange group since all of these lines are handled in the same manner. The second strip of each set represents tip party service and the third strip of each set represents a first or intermediate line of a private branch exchange trunk group. These strips are connected through the number group connector to equipment in the marker which controls the

establishment of a connection in accordance with information received therefrom.

When both the location of a line and its class of service is determined and a number is assigned thereto, two of the number terminals are cross-connected to the control terminal strips in accordance therewith. The third number terminal is connected directly to the winding of the line hold magnet and, therefore, to the sleeve of the line for determining its busy or idle condition.

Referring more specifically to the drawings, a call originated by a subscriber at substation 100 is extended by equipment, not shown, to an incoming junctor 101 which connects with an idle terminating sender 102 through a terminating sender link 102. The number of the wanted subscriber is then recorded on the terminating sender 102 which operates terminating marker connector 104 to summon a terminating marker.

When the sender and marker have been connected, the recorded designation is transferred to the marker and recorded on a set of registers represented by thousands relay 300, hundreds relay 301, tens relay 302 and units relay 303. The hundreds relay 301 indicates whether the hundreds digit is greater or less than 5 by operating relay 305 for digits greater than 5 and indicates the position of the digit in either series by operating one of five relays, such as relay 304. The thousands relay 300 marks one of ten conductors, such as conductor 306, which is extended to relay 307 or 308, according as relay 305 is or is not operated. Therefore, the joint operation of the thousands and hundreds register identifies a group of 500 lines by operating one of a set of twenty relays, such as relays 307 and 308.

The tens register represented by relay 302 discriminates between even and odd digits by operating relay 310 for odd digits and identifies blocks of twenty numbers by operating one of a set of five relays, such as relay 309, which in turn operates relay 311. The units register relay 303 grounds one of ten conductors, which are extended to twenty conductors, according to the operated or non-operated condition of relay 310.

The joint operation of relay 304 and relay 307 or 308 selects a number group frame by completing a circuit for a marker preference relay, such as relay 105 or 106. In each number group connector there is a marker preference relay for each marker and these preference relays are arranged in a chain so that only one marker can attach itself to a number group frame at a time. Assuming that the wanted number terminals are on number group frame 107, preference relay 105 is operated as soon as the frame is idle, operating a multicontact relay 108 which closes the necessary circuits between the marker and the number frame. With relay 108 operated, the hundred-block relay 109 is operated under the control of relays 304 and 308, there being one relay 109 for each hundred numbers included in the number group. With relay 109 operated, twenty-block relay 110 is operated under the control of relays 311 and 109, there being one such relay for each twenty numbers on the number group frame.

With relays 108, 109 and 110 operated, twenty sets of three terminals each on the number frame 107, such as sets 111 to 113 and 114 to 116, are marked by connecting them to equipment in the marker. For example, terminal 111 is connected over front contacts of relays 110 and 108 to the winding of the busy test relay 312, while terminal 114 is similarly connected to the winding of re-

lay 313. The corresponding terminals on the other eighteen sets are also connected to intermediate relays in the set of twenty busy test relays. Terminals 112 and 115 are connected to armatures of selecting relays 314 and 315, respectively, with the corresponding terminals of the remaining sets connected to armatures of intermediate relays of this group. Terminals 113 and 116 are connected over back contacts of relays 314 and 315 to the windings of relays 316 and 317 which become effective only in the case of terminal hunting groups.

As indicated above, in order to connect with a wanted line it is necessary to select the choice, frame and level 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 line choice relays 400, 401, 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 402 to 405 is provided. Each pair of relays 402 and 403 or 404 and 405 represents one of the ten levels and each relay represents a pair of frames, the two windings of each relay distinguishing between the frames of the pair. In order to differentiate between the three types of service, the line choice relays 400, 401, etc., have three windings and are energized over the different windings in accordance with the type of line. Therefore, there is a maximum of thirty conductors leading from the line choice relays and a maximum of forty conductors outgoing from the frame and level relays. These conductors are extended in multiple to all of the number frame connector relays, such as relay 100 and 131, and over contacts of these relays to sets of terminal strips on the number group frame. The operating conductors 406, 407 and 408 for relay 400 extend to terminal strips 117, 118 and 119, it being assumed that the terminal strip is rendered continuous across the frame by connections at the back. Similarly, the operating conductors 409 to 412 for the frame level relays 402 and 403 are connected over contacts of relay 108 to terminal strips 120 to 123.

The subscriber's line 200, when it enters the office, is connected to a distributing frame 201 from which the line is extended to one of the primary line switches 202 in accordance with traffic requirements. The line itself is connected to the line terminals 203 and 204, while individual to the line terminals 203 and 204 are the sleeve or busy terminal 205 and the message register terminal 206.

At the number group frame, assuming that the set of number terminals 111, 112 and 113 represent the number assigned to line 200, terminal 111 will be cross-connected over jumper 124 to terminal 205 individual to the position in the primary switch 202 assigned to line 200. According to the present disclosure, line 200 appears on the No. 0 level of the No. 0 frame in the No. 0 choice and is an individual message rate line. Therefore, terminal 112 is connected over jumper 125 to strip 120 and terminal 113 is connected over jumper 126 to strip 117.

When the twenty-block relay 110 operates as above described, the sleeve test circuit for line 200 extends from battery through the winding of relay 312, back contact of relay 314, over front contacts of relays 108 and 110, terminal 111, jumper 124, to the sleeve terminal 205 individual to the line. If the line is busy, relay 312 operates from the busy ground on the sleeve of the line.

At the same time, battery through the winding of relay 316 is connected over the back contact of relay 314, over contacts of relays 108 and 110 to terminal 113, jumper 126, strip 117, conductor 400, left winding of the No. 0 line choice relay 400 to battery. Therefore, relay 316 does not operate. After an interval to permit the busy test relays 312, 313, etc. to operate, ground is connected under the control of the units register to conductor 318, thereby operating relay 314, provided relay 312 is not operated. With relay 314 operated, ground is connected to conductors 319 and 320. Conductor 320 extends to terminal 113, over jumper 126 to strip 117, conductor 400, left winding of relay 400 and battery. The operation of relay 400 in this circuit identifies the No. 0 line choice. Relay 400 extends its operating ground to the winding of relay 413 to indicate that the wanted line is to be handled as an individual line. Conductor 319 extends to terminal 112, over jumper 125 to strip 120, conductor 409, left winding of relay 402 and battery. Relay 402 in operating identifies the No. 0 level and extends its operating ground over its inner left contact to the winding of relay 414 to identify the No. 0 frame. It may be noted that relays 414 to 417 represent the four frames of a choice and are operated from the corresponding energizing circuit for each pair of relays.

With relay 400 operated, the No. 0 line choice is selected by operating the marker preference relay 207, individual to the marker shown, in the No. 0 line choice connector. The marker preference relay operates the multicontact relay 208 which extends all of the control circuits through to the choice. The frame relay 414 closes a circuit from ground through the winding of relay 418, contact of relay 414 to the winding of relay 209, which is individual to the frame, over equipment (not shown) which determines that the frame equipment is free to handle a terminating call. Relay 418 operates if the frame equipment is idle and connects ground to the outer left contacts of the level relays 402, 404, etc., and, since relay 402 is assumed to be operated, operates horizontal level relay 210. Relay 210 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 above-identified application of Dehn et al. The hold magnet 211 of this line is operated over the front contact of relay 314 after an idle channel has been selected.

If the substation 200 represented the tip party of a two-party line, terminal 113 would be cross-connected to strip 118 operating relay 400 over conductor 407 and the middle winding of that relay which, in operating, would extend the operating ground to relay 419 to control the ringing and charging functions of the marker in accordance therewith.

If the substation 200 represented one of a group of private branch exchange trunks, terminal 113 would be cross-connected to strip 119 which is connected to conductor 408. Prior to the closure of the operating circuit for relay 314, relays 420 and 421 are operated, connecting ground to conductors 408, 422 and the corresponding operating conductors for each line choice relay. In this case, relay 316 and all similar relays included in the same private branch exchange group are operated so that the first idle trunk of the group may be selected. When an idle trunk has been found and the corresponding relay in the group

314, 315, etc., is operated, relays 420, 421, etc., release closing an operating circuit for the line choice relay through its right winding. When operated through its right winding, the line choice relay operates relay 423 to indicate that the line is one of a group of branch exchange trunks.

If, for any reason, it is desired to assign a different number to the line 200, for example that individual to the terminals 114, 115 and 116, the jumpers 124, 125 and 126 will be moved to terminals 114, 115 and 116, respectively, and no other change is necessary.

If, because of traffic conditions or other reasons, it is desirable to change the location of a line without changing the number, for example to the No. 9 level of the No. 2 frame of the No. 9 choice, the talking conductors are disconnected from the switch terminals 203 and 204 and transferred to terminals 212 and 213 at the desired location. The sleeve jumper 124 is disconnected from terminal 111 on the number group frame and jumper 127 is connected between terminal 111 and sleeve terminal 214 of the new primary line switch. The message register is also disconnected from the message register terminal 206 of the first switch and connected to the message register terminal 215 of the new location. At the number group frame, jumpers 125 and 126 are also disconnected and terminal 112 is connected by jumper 128 to strip 129, while terminal 113 is connected to strip 130. Therefore, the No. 9 line choice relay 401 is operated through its left winding and frame level relay 405 is operated through its left winding.

Line choice relay 401 causes the selection of the No. 9 line choice by operating the preference relay 216 of that choice. Relay 405 causes the operation of frame relay 416 which selects the No. 2 frame in the choice, while relay 405 selects the No. 9 level on that frame.

It is, therefore, apparent that this arrangement provides great flexibility of line arrangement, it being possible to spread busy groups of private branch exchange trunks over all choices, thereby relieving the load on any one choice.

What is claimed is:

1. In a telephone system, subscribers' lines identified by directory numbers, automatic switches, control equipment common to said lines and said switches, a set of terminals individual to each directory number, a set of terminals individual to each line in said switches, means to individualize one of said sets of number terminals with one of said sets of line terminals, means responsive to the registration of a directory number in said control equipment to connect said control equipment with the corresponding set of number terminals, and means in said control equipment responsive to said connection to control the connection of said control equipment with the set of line terminals individualized with said number terminals.

2. In a telephone system, a plurality of lines, a plurality of switches in which said lines appear, control equipment common to said lines and to said switches, sets of terminals individual to the directory numbers, means to individualize said sets of terminals to subscribers' lines, means to register the number of a wanted line in said control equipment, means in said control equipment responsive to said registration to seize the corresponding set of terminals, means in said control equipment operated over said set of terminals to record the location of the correspond-

ing line, and means under the control of said record for connecting said control equipment with the switch in which said line appears.

3. In a telephone system, a plurality of lines, 5
a plurality of switches in which said lines appear, control equipment common to said lines and to said switches, a cross-connecting rack, means to register the directory number of a line in said control equipment, means responsive to 10
said registration to select a set of terminals on said cross-connecting rack individual to said number, means to individualize said set of terminals to a subscriber's, means including said set of terminals to transmit to said control equipment information characteristic of the nature 15
and location of said line, and means responsive to the transmission of said information to connect said control equipment with the switch in which said line appears.
- 20 4. In a telephone system, a plurality of lines, a plurality of switches in which said lines appear, said switches being arranged in levels, frames and choices, control equipment common to said lines and to said switches, a cross-connecting rack, sets of terminals on said rack individual to directory numbers, means to individualize 25
said sets of terminals to subscribers' lines, means to register a directory number in said control equipment, means responsive to said registration to connect said control equipment with the cross-connecting rack and the set of terminals individual to said number, means operated 30

over said set of terminals to record the identity of the choice, frame and level on which the corresponding line is located, and means responsive to said record for connecting said control equipment with said choice, frame and level for completing the connection with said line. 5

5. In a telephone system, a plurality of lines, a plurality of switches in which said lines appear, said switches being arranged in levels, frames and choices, control equipment common to said lines 10
and to said switches, a cross-connecting rack, sets of terminals on said rack individual to directory numbers, means to individualize said sets of terminals to subscribers' lines, terminal strips on said rack for each choice, terminal strips on 15
said rack for each frame level, means to cross-connect said sets of terminals with said terminal strips in accordance with the location of the line individualized thereto, means to register a directory number in said control equipment, means 20
responsive to said registration to connect said control equipment with the cross-connecting rack and the set of terminals individual to said number, means operated over said set of terminals and said terminal strips to record the identity 25
of the choice, frame and level on which the corresponding line is located, and means responsive to said record for connecting said control equipment with said choice, frame and level for completing the connection with said line. 30

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