

Nov. 2, 1943.

W. H. T. HOLDEN
COMMUNICATION SYSTEM

2,333,179

Filed May 5, 1942

5 Sheets-Sheet 1

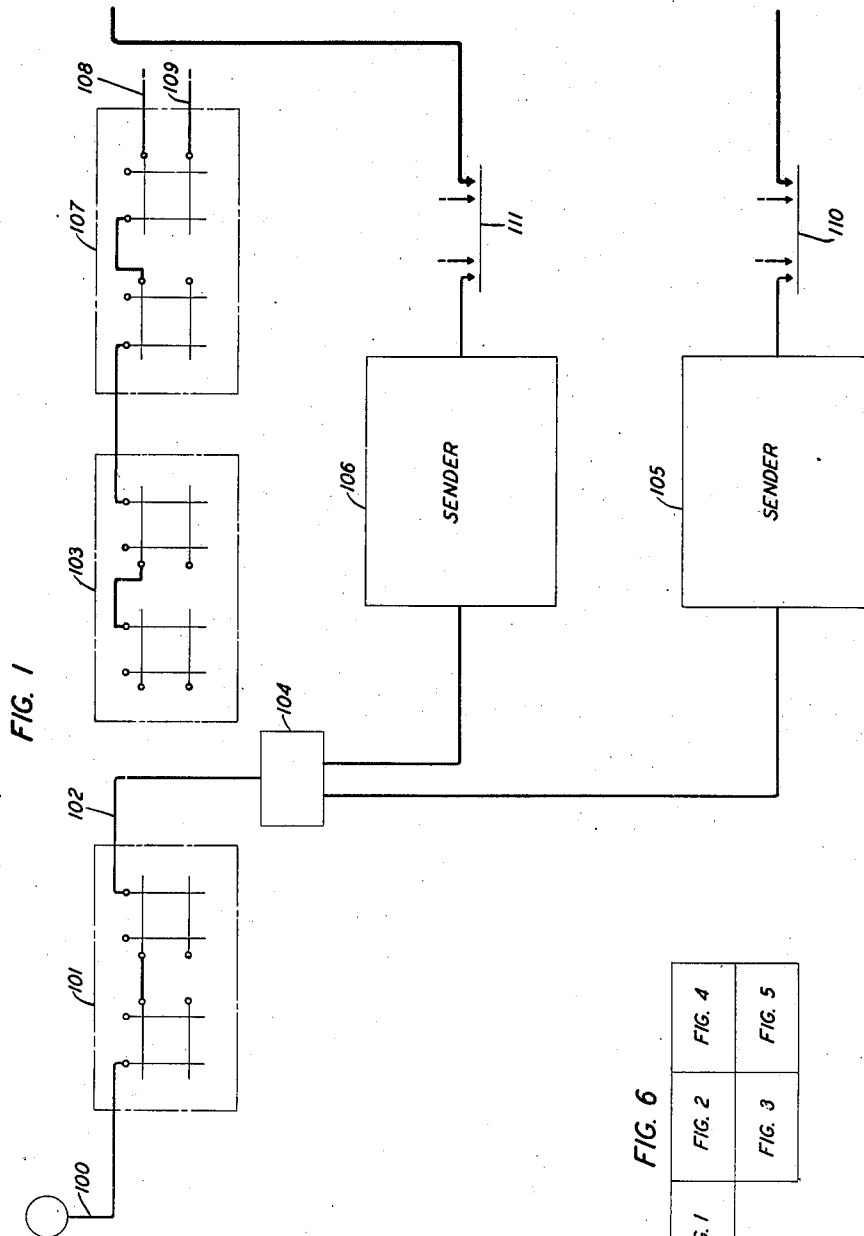


FIG. 6

FIG. 1	FIG. 2	FIG. 4
	FIG. 3	FIG. 5

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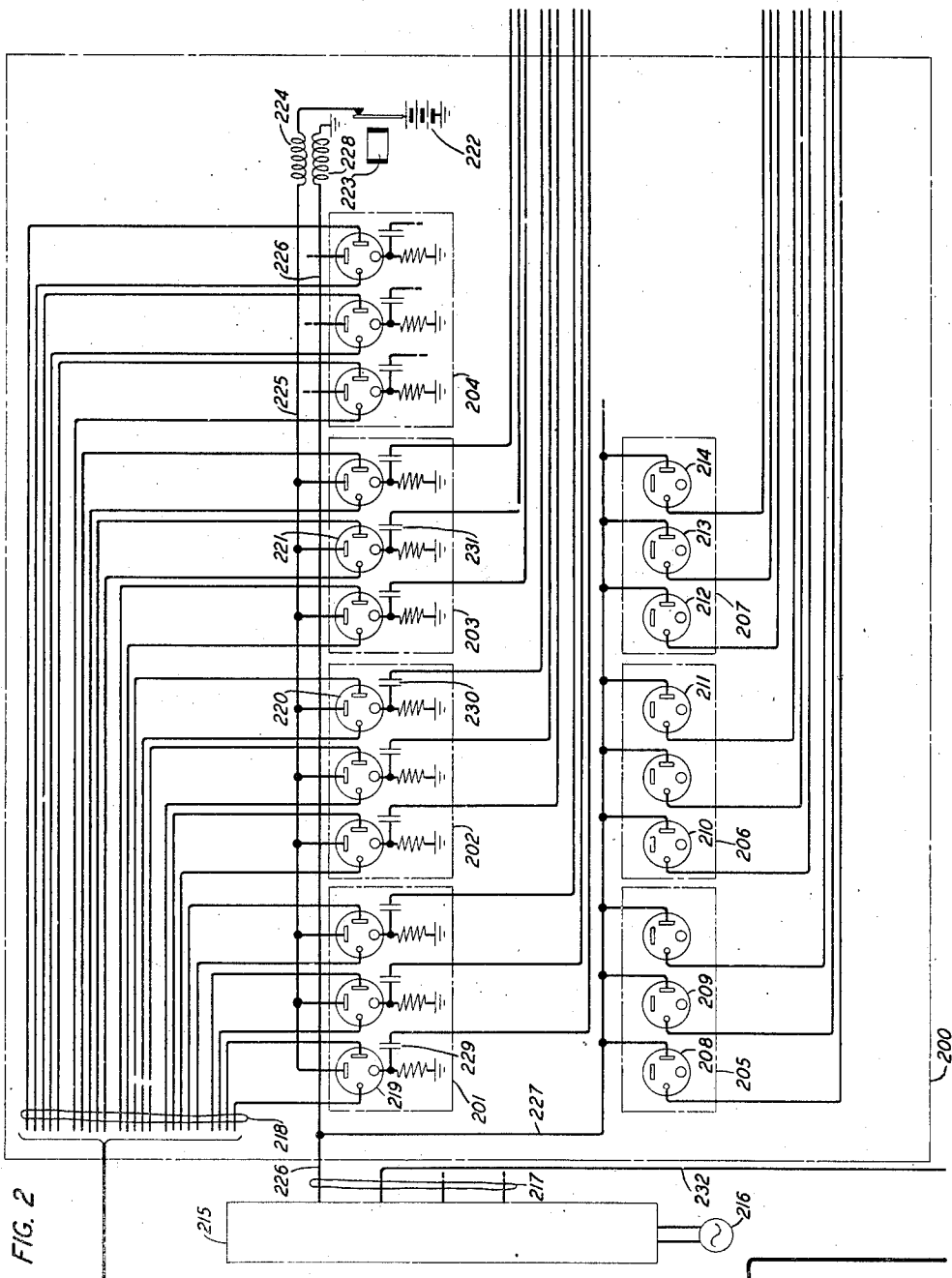
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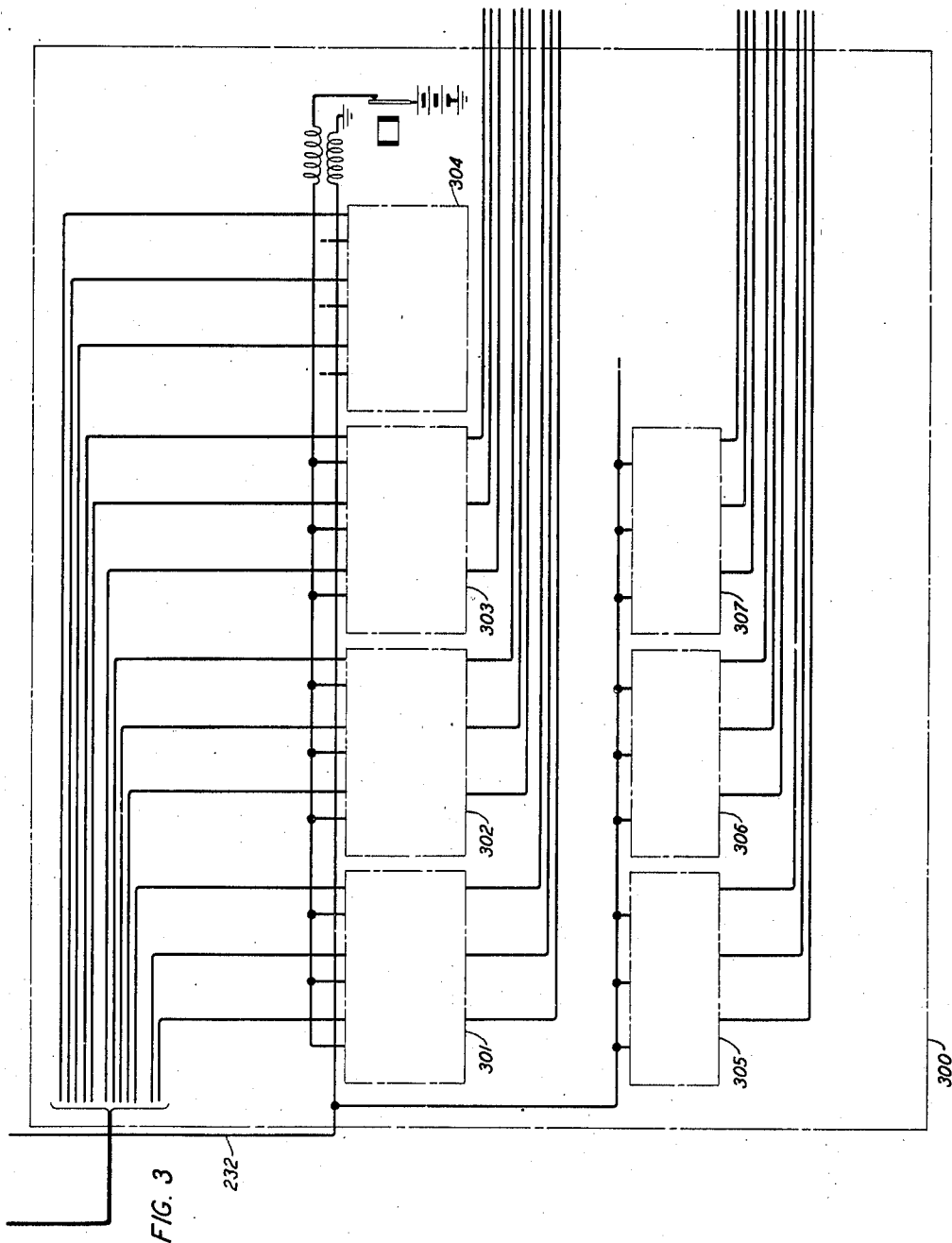
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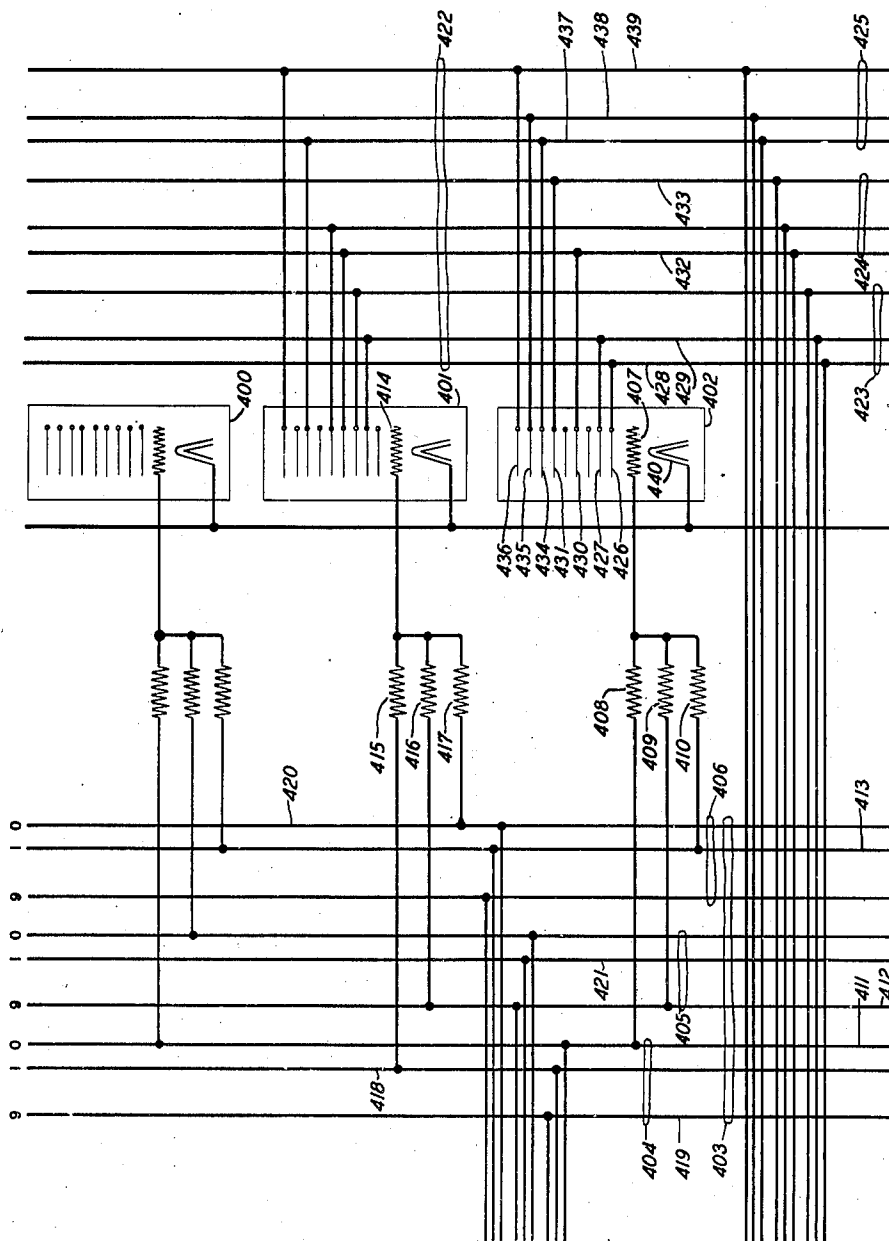
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FIG. 4



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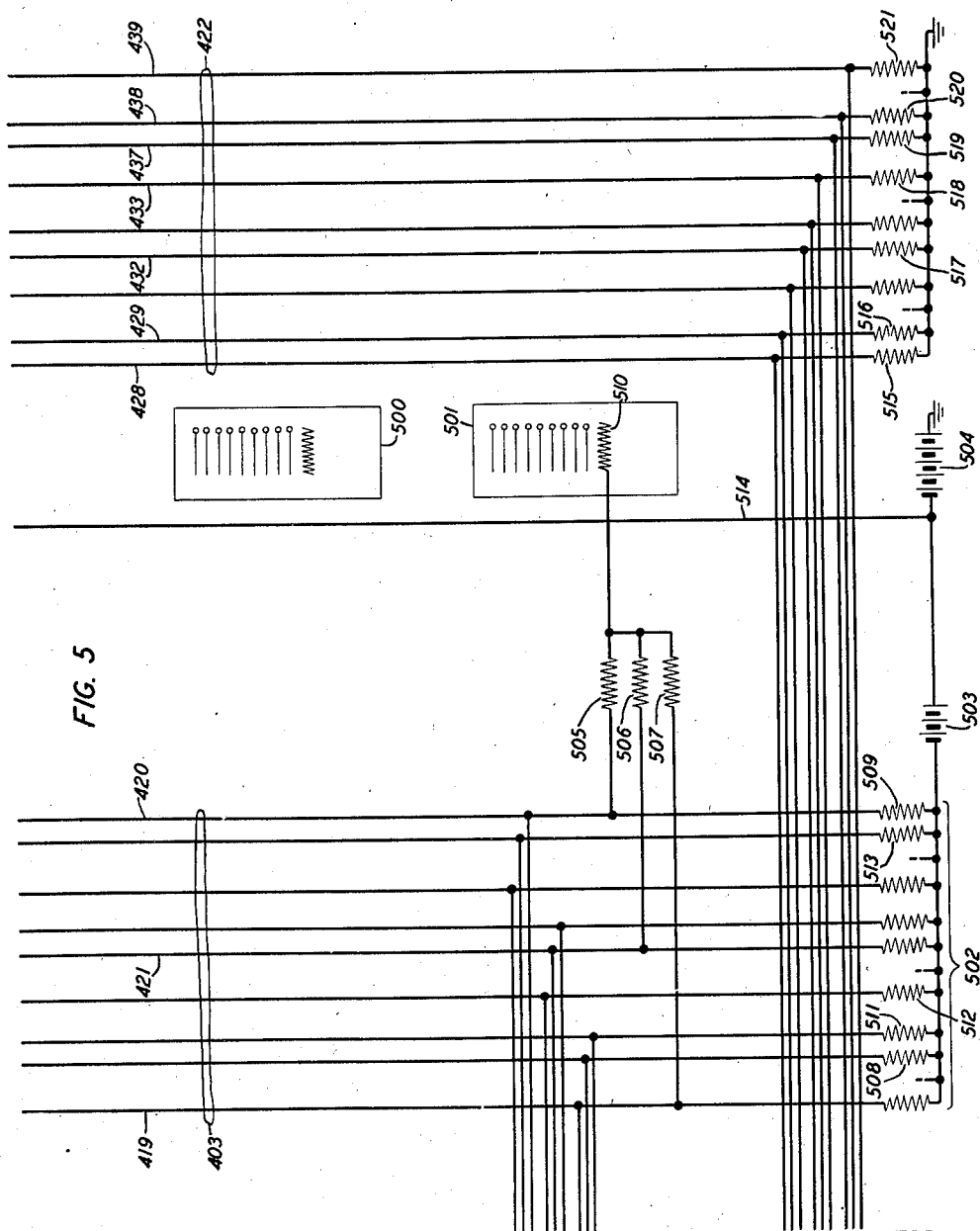
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W. H. T. HOLDEN
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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,333,179

COMMUNICATION SYSTEM

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Application May 5, 1942, Serial No. 441,786

7 Claims. (Cl. 179—18)

This invention relates to communication systems and particularly to telephone systems in which connections are established automatically.

An object of the invention is to effect economies by minimizing the amount of controlling equipment used in the establishment of the connections.

More specifically an object of the invention is to omit certain essential routing equipment from each of the several switch-controlling markers in an automatic telephone office and to provide a single one of these routing equipments for the common use of all markers.

Another object is to simplify these systems still further by dispensing with the conventional switching devices for connecting the several markers to the common routing equipment and by utilizing discriminating signals to obviate interference in the use of this common equipment.

A still further object is to enable all of the switch-controlling markers in concurrent use to have access to the common routing equipment without waiting and without interference with each other.

These and other objects of the invention are realized by means of a system in which a group of route tubes of the discharge type are provided in common to a number of switch-controlling markers for determining the routes over which the desired connections are to be established. This common group of route tubes is accessible to the markers over a permanent wire multiple interconnecting the group of tubes with each of the several markers having access thereto. Since two or more of the markers may be in use concurrently, it is desirable that each marker have access to the route tubes without being required to wait for other markers. This free access without interference is accomplished by utilizing a system of signaling between the markers and the route tubes in which signals of different phases are provided, each marker being characterized by a particular phase, for transmitting the information from the marker to the route tubes to determine the selection of the desired one and for transmitting the decoded information from the selected tube back to the particular marker that seized the tube. Inasmuch as the several markers concurrently in use are in communication with the route tubes in successive phases, no interference exists between the markers, and each marker is free to seize, in its own phase, any one of the tubes and to receive the necessary information from that tube without interference either

with or from other markers. In fact, two or more markers concurrently in use may avail themselves of the same route tube without interference.

These and other features of the invention will be discussed more fully in the following detailed specification.

In the drawings accompanying the detailed specification:

Figs. 1 to 5, when arranged in the order indicated in Fig. 6, illustrate a portion of an automatic telephone system in which the present invention is embodied.

Fig. 1 shows a calling subscriber's line, a line switch, district and office selector switches, two central office senders and connecting devices for said senders;

Figs. 2 and 3 illustrate two switch-controlling markers. Fig. 2 also shows an impulse generator for supplying impulses to the markers; and

Figs. 4 and 5 illustrate a plurality of route tubes common to the switch-controlling markers together with a connecting multiple for joining these tubes to all of the markers.

Automatic telephone systems of the crossbar type now in use comprise a number of central office register senders and a number of common markers for controlling the selective operation of the crossbar switches to establish the desired connections. The designations transmitted over the subscribers' lines by dial impulses are first received and registered in the senders. The sender thus taken in use associates itself with an idle one of the markers and transmits thereto that part of the entire designation which represents the office code or the route over which the call is to be extended toward the called line. The marker receives this information and uses it to select and operate a number of route relays, the relay thus chosen representing the particular route over which the call is to be extended. The operated route relay in the marker serves to determine the association of the marker with the desired trunk group for testing purposes and also causes signals to be transmitted back into the sender to register therein the various types of route information which the sender requires in order to proceed with the further extension of the call. In areas involving a multiplicity of offices the markers in any particular office may be called upon to route the calls over a large number of outgoing trunk groups, thus requiring a correspondingly large number of route relays and associated connections in each marker provided in the office.

As previously explained the system disclosed herein contemplates the saving of the numerous route relays now provided in each of the central office markers by substituting a common group of route tubes of the discharge type, all of which are readily accessible to any marker that requires route information. Moreover, these common route tubes are connected to the several markers by means of a permanent set of multiple conductors rather than the relay or switch type of connector that is usually employed for making connections with common equipment. Notwithstanding this permanent connection between the markers and the common route tubes, no interference occurs between the markers although a number of them may be working concurrently on calls. This freedom from interference is achieved by utilizing a system of signaling between the markers and the route tubes in which impulses of different phases are employed, each phase being individual to and characterizing a particular one of the markers. Thus two or more markers working concurrently on separate calls make use of the same tubes in the common group in their own separate phases without interference.

Inasmuch as the present invention is concerned, particularly with the routing equipment associated with the markers, it is not considered necessary to disclose the details of the other parts of the system. However, an understanding of a system of the crossbar type to which the invention may be applied may be had from the patent to Carpenter 2,235,803 of March 18, 1941.

Referring to the drawings for a general understanding of the present system, a subscriber's line 100, appearing in a frame of line switches 101, has access over district trunks 102 to a frame of district switches 103 and also through a sender connector 104 to an idle one of a number of senders 105, 106. The district switches 103 have access through the switches of an office frame 107 to trunks 108, 109 outgoing over a large number of routes to terminating switching equipment in the same or in distant offices. The central office, in which these switches and senders are located, is also provided with a plurality of switch-controlling markers 200, 300. Any one of the senders may seize any idle one of these markers and connect itself thereto through the marker connectors 110, 111.

Each of the markers is provided with registers for receiving and registering the office code designation. This code designation is transmitted to the marker from the sender together with other information concerning the class of the calling line and the identity of the district frame to which the calling line has been extended. For example, the marker 200 is provided with registers 201, 202 and 203 for registering the three digits of the office code. Each of these registers comprises a series of ten space discharge tubes, only three tubes per register being illustrated in the drawing. The register 204 may serve to register the class information concerning the calling line, and, as above noted, other registers may be provided in the marker for receiving further information concerning the call from the sender.

Each of the markers is also equipped with a plurality of registers for receiving and storing the decoded information from the route tubes. In the marker 200, three of these registers, 205, 206 and 207, are illustrated. Each of these registers comprises a plurality of discharge tubes, there being as many tubes as are necessary to store the

information received from the route tubes. The registers 205, 206, 207 serve to control the connection of the marker to the switch frames for testing the desired group of trunks, to make the necessary comparisons between the class of the calling line and the class of the office to which connection is attempted, and to transfer back to the sender all information required by the sender for controlling the further extension of the call in the distant offices.

The marker 300, like marker 200, is also provided with registers 301, 302, 303, 304, which receive the office code and other information from the sender, and with registers 305, 306, 307 which receive the decoded information from the common group of route tubes.

All of the markers 200, 300, etc., in the office are provided with a common group of route tubes including the tubes 400, 401, 500 and 501, there being one of these tubes for each route over which calls may be extended. The route tubes are selected and operated by the markers over a common wire multiple 403 which is permanently connected to the code registers of all markers and to the control electrodes of all route tubes. The multiple 403 consists of three groups of conductors 404, 405 and 406, each group having ten conductors therein. The ten conductors in the group 404 are connected through condensers to the main cathodes of the ten respective tubes of the first office code register 201 in the marker 200 and in multiple to the tubes of register 301 of marker 300 and to the tubes of the corresponding register of all other markers in the office. The ten conductors of the second group 405 are connected through condensers to the cathodes of the ten respective tubes of the second office code register 202 of marker 200, in multiple to the tubes of the register 302 of marker 300, and similarly to the registers of all other markers. In like manner the ten conductors of the third group 406 are connected to the tubes of the third code registers 203, 303, etc., in the respective markers. Each one of the thirty multiple conductors 403 is connected through an individual one of a group of resistors 502 to the negative pole of the biasing battery 503, the positive pole of battery 503 being connected to the negative pole of the anode battery 504. When an office code registration is set up on the registers 201, 202 and 203, or on the corresponding registers in any other marker, the discharge of the operated register tubes in the phase assigned to that particular marker causes current to flow over one of the conductors in each of the three groups 404, 405 and 406 through the resistors 502 to batteries 503 and 504. This current flow through the resistors 502 sets up potentials on the multiple conductors 403, and these potentials are applied to the control electrodes of the route tubes in a manner now to be described.

The control electrodes of the route tubes 400, 401, 402, etc., are connected in varying combinations, each electrode to a particular combination of three of the multiple conductors 403. Since there are thirty of these conductors, ten for the ten decimal values of each of the three places of the office code, the route tube for any particular office code is determined by connecting the control electrode of that tube to the three corresponding decimal conductors in the group of thirty. For example, if tube 402 represents office code "091" the control electrode 407 of this tube is connected as shown through resistors 408,

409 and 410 to the No. 0 conductor 411 in the first group 404, to the No. 9 conductor 412 in the second group 405, and to the No. 1 conductor 413 in the third group 406. Similarly, if route tube 401 represents the office code "190," its control electrode 414 is connected through the resistors 415, 416 and 417 to the No. 1 conductor 418, to the No. 9 conductor 412, and to the No. 0 conductor 420. Likewise tube 501, which represents office code "910" has its control electrode 510 connected through resistors 505, 506 and 507 to the No. 9 conductor 419, to the No. 1 conductor 421, and to the No. 0 conductor 420. And in like manner all of the remaining route tubes in the common group have their control electrodes connected in different combinations to the multiple conductors 403.

The route tubes 400, 401, 402, etc., which are preferably of the vacuum type, including a cathode, a control electrode or grid, and a plurality of anodes. The biasing battery 503 is applied across the cathode and control grid of all tubes, and normally these tubes do not conduct. In order to cause one of the tubes to conduct it is necessary to apply to its grid a positive potential equal in value to the full potential that exists on the multiple conductors 403 when current is flowing therein from the register tubes in one of the markers. If a lesser positive potential is applied to the grid electrode of the route tube, the tube will fail to conduct in its main discharge gap. It will be noted that the connection of the grid of each route tube to the common multiple conductors 403 includes three resistors in parallel. For example, the grid of tube 402 is connected in parallel through resistors 408, 409 and 410 to conductors 411, 412 and 413. If the full operating potential exists on conductors 411, 412 and 413, indicating that the code registered in the marker is "091," no current flows in any one of the resistors 408, 409, 410, and full operating potential appears, therefore, on the grid 407, causing the tube 402 to conduct. Route tube 401 also has its control electrode connected through resistor 416 to conductor 412 on which potential exists under this assumption, but no potential is present on the other two conductors 418 and 420 to which electrode 414 is connected. Therefore, circuits may be traced for the flow of current from conductor 412 through resistance 416 and in parallel through resistances 415 and 417, conductors 418 and 420, resistors 508 and 509 to batteries 503 and 504. Accordingly the full potential on conductor 412 is not applied to the electrode 414, and the tube 401 does not conduct. In like manner other route tubes will have their control electrodes connected to one or two of the conductors 411, 412, 413 with the result that full potential is not applied to any one of these tubes. Hence, only the tube 402 will operate in response to the application of potential to these three conductors. This method of selection by the use of varying potentials, in which increments varying from zero potential up to the full operating value are applied to a plurality of tubes, is described more fully in the patent to L. A. Meacham, No. 2,317,471 of April 27, 1943.

The routing information determined by the operated route tubes is transferred back to the markers over a second conductor multiple 422 which is permanently connected between the anodes of the route tubes and the registers in

the markers to which the routing information is transferred. The wire multiple 422 is divided into as many groups 423, 424, 425, etc., as there are items of routing information required by the marker and the associated sender. Only the three groups 423, 424, and 425 have been illustrated, and these are connected to the three associated registers 205, 206 and 207 in the marker 200 to the registers 305, 306 and 307 in the marker 300 and to corresponding registers in all other markers. The number of conductors in each of these groups will depend upon the number of tubes needed in the associated register to register the route information. Three are shown, and as many more as necessary will be provided; but usually the information can be expressed in some code requiring less than ten conductors and associated register tubes. Each of the multiple conductors 422 is connected through an individual resistor to ground in order that current flowing in these resistors will develop potentials on the conductors which serve to ionize the tubes in the marker registers.

The anodes of the route tubes are connected to the conductors of the groups 423, 424 and 425 in combinations that represent the items of information to be transferred back to the markers. For example, the anodes 426 and 427 of tube 402 are connected to conductors 428 and 429 of the group 423, and these two conductors are connected respectively to the starting cathodes of tubes 208 and 209 of the marker register 205. Anodes 430 and 431 are connected to multiple conductors 432 and 433 of the second group 424, and these conductors are connected to the starting electrodes of tubes 210 and 211 of register 206. Anodes 434, 435 and 436 of the tube 402 are connected to conductors 437, 438 and 439 of the third group 425, and these in turn are connected to the starting cathodes of tubes 212, 213, and 214 of the register 207. Similarly other anodes in the tube 402 may be connected to the conductors of other groups for the operation of corresponding registers in the marker. Since the conductors 422 are multiplied to all markers, the connections above described also extend to the starting cathodes of the corresponding tubes in the registers 305, 306 and 307 of marker 300 and to the corresponding registers of other markers not shown in the drawing. When, therefore, any marker receives the office code designation "091," the route tube 402 operates and applies operating potential to conductors 422 in the combinations just described, causing in turn the operation of the marker register tubes, such as the tubes 208, 209, 210, 211, 212, 213 and 214 in the marker 200. The detailed operating circuits for these register tubes will be described more fully hereinafter. Since the different route tubes 400, 401, 402, 500, etc., represent different routes requiring different items of information in the marker and sender, it follows that the anodes of these tubes are connected to the common conductor multiples 422 in combinations that vary from one tube to the next. The connections for the anodes of tube 401 are also illustrated and it will be understood that the anodes of the remaining route tubes are connected to the conductors 422 in the proper combinations for transferring the corresponding routing information to the markers.

It has already been stated that the markers have concurrent access to the route tubes of the common group without interference by means of a system of signaling in which a characteristic

phase is assigned to each of the several markers. The signal impulses of the several phases are produced by an impulse generator 215 supplied with a source of alternating current 216. During each cycle of the source 216 signal impulses of the successive phases are produced in the impulse leads 217, and these impulses are delivered in succession to the respective markers. Each marker in use causes the transmission of impulses of its phase to the multiple conductors 403 for the purpose of selecting the route tube representing the office code registered in the marker, and the operated route tube causes the transmission of impulses of the same phase over conductors 422 to select and operate the proper tubes in the route information registers of that marker.

To explain the operation of the system more fully it will be assumed that the subscriber of line 100 wishes to call a subscriber whose line has the office designation "091." In response to the initiation of the call the line 100 is extended through the line switch frame 101 to an idle trunk 102 and thence through a sender selector 104 to an idle register sender 106. After the designation has been received in the sender 106, the connector 111 operates to connect the sender to an idle marker 200. Thereupon the operated registers in the sender 106 cause the application of positive and negative potentials to the conductors 218 in combination such that the starting gaps of the No. 0 tube 219 of register 201, the No. 9 tube 220 of register 202, and the No. 1 tube 221 of register 203 are ionized. Also the starting gaps of the proper tubes in each of the remaining registers 204, etc., are ionized over the conductors 218. As soon as the starting gaps of these register tubes are ionized, current flows from the positive pole of battery 222 through the contacts of relay 223, transformer winding 224, conductor 225 thence through the main anodes of the ionized tubes to the main cathodes of these tubes and thence through the individual resistors to ground. In this manner the selected tubes are operated and their main gaps are ionized by current flowing from the anode battery 222. However, the potential applied to the corresponding conductors of the multiple 403 is insufficient to cause the operation of the route tubes. Thus the office code designation is transferred and registered in the marker together with any other information such as the class of the calling line, district frame number, etc., that may be required by the marker.

As soon, following the ionization of register tubes 219, 220 and 221, as the generator 215 enters the phase allotted to the marker 200, an impulse is sent out from the generator over impulse lead 226, through the transformer winding 228 to ground. The current impulse flowing in the winding 228 induces an impulse in winding 224, and this impulse is transmitted through the conducting tubes 219, 220 and 221 through the respective condensers 229, 230 and 231 to the multiple conductors 411, 412 and 413. These impulses flow through the resistors 511, 512 and 513 to batteries 503 and 504, and in so doing set up equal potentials on the conductors 411, 412 and 413. Since these potentials are all equal, no current flows through resistors 408, 409 and 410, and the full value of the potential is applied to the grid 407. The potential thus applied to grid 407 being positive, the bias of battery 503 is overcome, and the tube 402 passes current between its cathode and its several anodes. The circuit for the flow of anode current in the tube 402 may

be traced from the negative pole of battery 504, conductor 514, cathode 440, anodes 426, 427, 430, 431, 434, 435 and 436 thence over conductors 428, 429, 432, 433, 437, 438 and 439 through resistors 515, 516, 517, 518, 519, 520 and 521 to the grounded or positive pole of battery 504. Each time the impulse generator 215 passes through the phase of marker 200, the tube 402 conducts, and current impulses flow through the resistors 515, 516, 517, etc. The flow of these current impulses through the resistors lowers the potential of the corresponding conductors of the multiple 422 to a given value, and these negative potential impulses are applied to the starting cathodes of the registers 205, 206 and 207 and to the corresponding registers in other markers. More specifically, the negative potential impulses appearing on conductors 428, 429, 432, 433, 437, 438 and 439 are applied respectively to the starting cathodes of tubes 208, 209, 210, 211, 212, 213 and 214. At the same instant that these negative potential impulses are being applied to the starting cathodes of the tubes in marker 200, positive impulses of the same phase are also being applied over conductor 227 to the starting anodes of the register tubes in this marker. The sum of the positive and negative impulses on the cathodes and anodes being sufficient to cause ionization, tubes 208, 209, 210, 211, 212, 213 and 214 ionize, whereas all other tubes of these registers remain inert. Although the negative impulses on conductors 428, 429, 432, etc., are applied to the starting cathodes of the tubes in the other markers these impulses do not correspond in phase with the positive impulses that are being applied to the starting anodes of these tubes. Consequently only the code information registers 205, 206, and 207 in the marker 200 are affected by the operated route tube 402.

At the time the marker 200 is causing the repeated operation of route tube 402, once per cycle of the source 216, and is receiving the code information impulses of like phase from the route tube, another marker, such as the marker 300, may also be in the process of operating one of the route tubes for a similar purpose. If, for example, the marker 300 has been seized by a sender 105, the registered information in the sender is transferred to the code registers 301, 302, 303, 304 of marker 300, and at each cycle of the source 216 an impulse of the phase which characterizes the marker 300 is delivered over impulse conductor 232 to the operated tubes of the registers 301, 302, 303 and to the starting anodes of the route information registers 305, 306 and 307. The impulses passing through the operated tubes of registers 301, 302, 303 cause the application of potentials to the multiple conductors 403 in a combination which results in the operation of the desired one of the route tubes, and the operated route tube returns the routing information over the multiple conductors 422 to cause the operation of the proper ones of the tubes of registers 305, 306 and 307. No interference takes place between the markers 200 and 300 although they are both making use of the common multiple conductors 403 and 422 and may even be operating the same route tube. They do not interfere for the reason that each marker has its own individual phase, and during the brief interval of that particular phase the marker has exclusive use of the common multiple conductors and the common route tubes.

Returning to the call which it is assumed that the line 100 is making, as soon as the marker 200 receives the routing information from the tube

402, it proceeds to connect itself to the district and office frames 103 and 107 and to transfer certain routing information back into the sender 106. The marker controls the setting of switches 103 and 107 to extend the trunk 102 to the desired outgoing trunk, such as the trunk 108. Thereafter the sender 106 controls the completion of the connection, the connector 111 releases the marker 200, and the latter restores to its normal condition. The operated tubes in the marker, which are preferably of the gas-filled type, may be released in any well-known manner. For example, the operated tubes in the registers 201, 202, 203 are restored by operating the relay 223 to open the anode circuits of these tubes.

The register tubes disclosed herein may be of any suitable type. Preferably they have separate starting gaps and main discharge gaps. For a better understanding of a tube of this type reference is made to the patent to W. H. T. Holden No. 2,273,958 of February 24, 1942. As mentioned hereinbefore, the route tubes are preferably of the vacuum type in order that they may be fast enough to follow the rapid impulses delivered from the generator 215 and to conserve the holding time of the markers which make common use of these tubes.

What is claimed is:

1. The combination in a signaling and switch-controlling system, in which a plurality of equivalent switch-controlling markers are provided for determining the routes over which connections are established in accordance with desired designations, of a group of route devices common to the use of all of said markers, each of said route devices characterizing a particular route over which connections may be set up under the control of said markers, means for seizing any one of said markers and for registering a desired designation therein, time-controlled means for seizing and operating the corresponding one of the route devices in said common group, and means effective in response to the operated route device for transmitting back to the marker that seized it routing information required by the marker for establishing the connection represented by said desired designation.

2. The combination in a signaling and switch-controlling system, in which a plurality of switch-controlling markers are provided for controlling the establishment of connections over the routes represented by desired designations, of a group of route devices common to the use of all of said markers, each of said route devices characterizing a particular route over which connections may be set up under the control of said markers, means for seizing any one of said markers and for registering a desired designation therein, means for generating impulses of each of a plurality of different phases, said phases being assigned individually and respectively to said markers, means controlled in accordance with the designation registered in any one of said markers for selectively operating in phase with the impulses of the phase assigned to said marker the particular route device corresponding to the registered designation, and means effective in response to the operated route device for transmitting to said marker signals of the particular phase assigned thereto and representing the routing information required by the marker for establishing the desired connection.

3. The combination in a signaling and switch-controlling system, in which a plurality of switch-controlling markers are provided for controlling

the establishment of connections over the routes represented by desired designations, of a group of route discharge tubes common to all of said markers, each of said tubes representing a particular route over which connections are extended under the control of any one of said markers, means for taking any one of said markers into use and for registering a desired designation therein, means for supplying each marker with a succession of impulses of a particular phase, the phase assigned to each marker differing from those of the other markers, means controlled by any marker taken into use for selectively operating a particular one of said route tubes in phase with the impulses supplied to said marker, and means effective in response to the operated route tube for transmitting to said marker signals of the phase assigned to said marker and representing the route information required by the marker for establishing the desired connection.

4. The combination in a switch-controlling system, in which a plurality of equivalent markers are provided for determining the routes over which connections are established in accordance with the desired designations, of a group of route tubes common to all said markers, each of said tubes characterizing a particular route over which connections may be extended under the control of any one of said markers, means for seizing a plurality of said markers for concurrent use and for registering designations in the markers thus seized, means for supplying each marker with impulses of a particular phase, the phase assigned to each marker differing from that assigned to other markers, means controlled in accordance with the designation registered in each of the seized markers for selectively operating in phase with the impulses supplied thereto the particular route tube of said group which represents the registered designation, and means controlled by any one of said route tubes when operated in any one of said phases for establishing in the particular marker to which the phase is assigned the routing information required by the marker for establishing the connection represented by the designation registered therein.

5. The combination in a switch-controlling system, in which a plurality of equivalent markers are provided for determining the routes over which connections are established in accordance with desired designations, of a group of route tubes common to all said markers, each of said tubes characterizing a particular route over which connections may be extended under the control of any one of said markers, means for seizing a plurality of said markers for concurrent use and for registering designations in the markers thus seized, means for supplying each marker with impulses of a particular phase, the phase assigned to each marker differing from that assigned to other markers, a set of circuit conductors connecting the route tubes of said group in permanent multiple relation to all of said markers, means effective in accordance with the designation registered in each one of said markers for applying to said multiple conductors impulses of the phase assigned to such marker to operate selectively the particular route tube representing the route of the designation registered in said marker, and means effective in response to the operation of any route tube in any one of said phases for transmitting impulses of such phase over said multiple conductors to establish in the particular marker to

which such phase is assigned the routing information required by the marker for establishing the connection represented by the designation registered therein.

6. The combination in a signaling and switch-controlling system, in which a plurality of equivalent switch-controlling markers are provided for determining the routes over which connections are established in accordance with desired designations, of a group of route devices common to the use of all of said markers, each of said route devices characterizing a particular route over which connections may be set up under the control of said markers, multiple conductors permanently joining all markers with each of said route devices, means for seizing any one of said markers and for registering a desired designation therein, means dependent on the registered designation for applying to said multiple conductors signal potentials for seizing and operating the particular route device which corresponds to the registered designation, and means effective in response to the operated route device for transmitting back to the marker that

seized it routing information required by the marker for establishing the connection represented by said desired designation.

7. The combination in a signaling and switch-controlling system, in which a plurality of equivalent switch-controlling markers are provided for determining the routes over which connections are established in accordance with desired designations, of a plurality of discharge tubes common to the use of all of said markers, each tube serving to characterize a particular route over which connections may be set up under the control of said markers, means for seizing any one of said markers and for registering a desired designation therein, means controlled in accordance with the registered designation for seizing and operating the corresponding one of said route tubes, and means effective in response to the operated route tube for transmitting back to the marker that seized it routing information required by the marker for establishing the connection represented by said desired designation

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