May 6, 1941. G. V. KING ET AL 2,241,016

TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 1

FIG. 12

FIG. 1	FIG. 2	FIG. 5	FIG. 8	FIG. 11
FIG. 3	FIG. 4	FIG. 7	FIG. 10
	FIG. 6	FIG. 9	

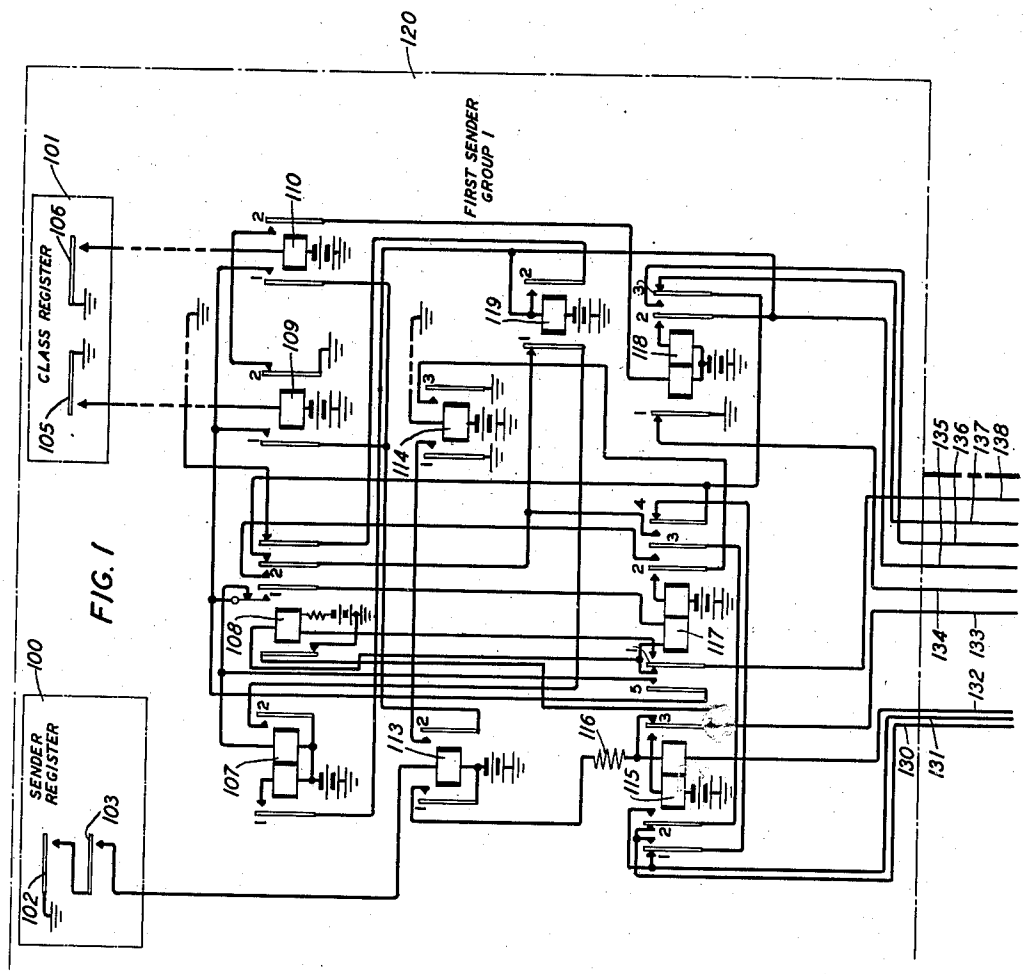

FIG. 1

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May 6, 1941. G. V. KING ET AL 2,241,016

TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 2

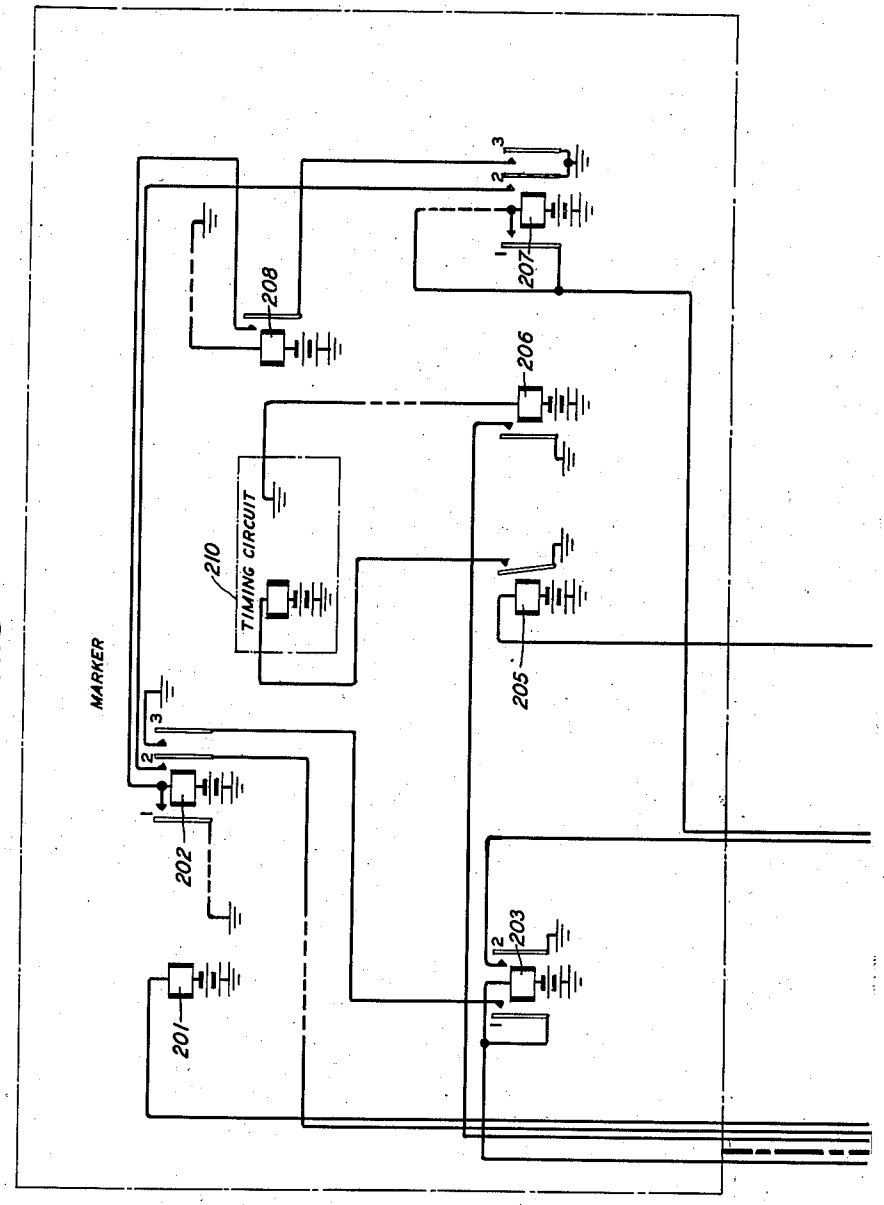

FIG. 2

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TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 3

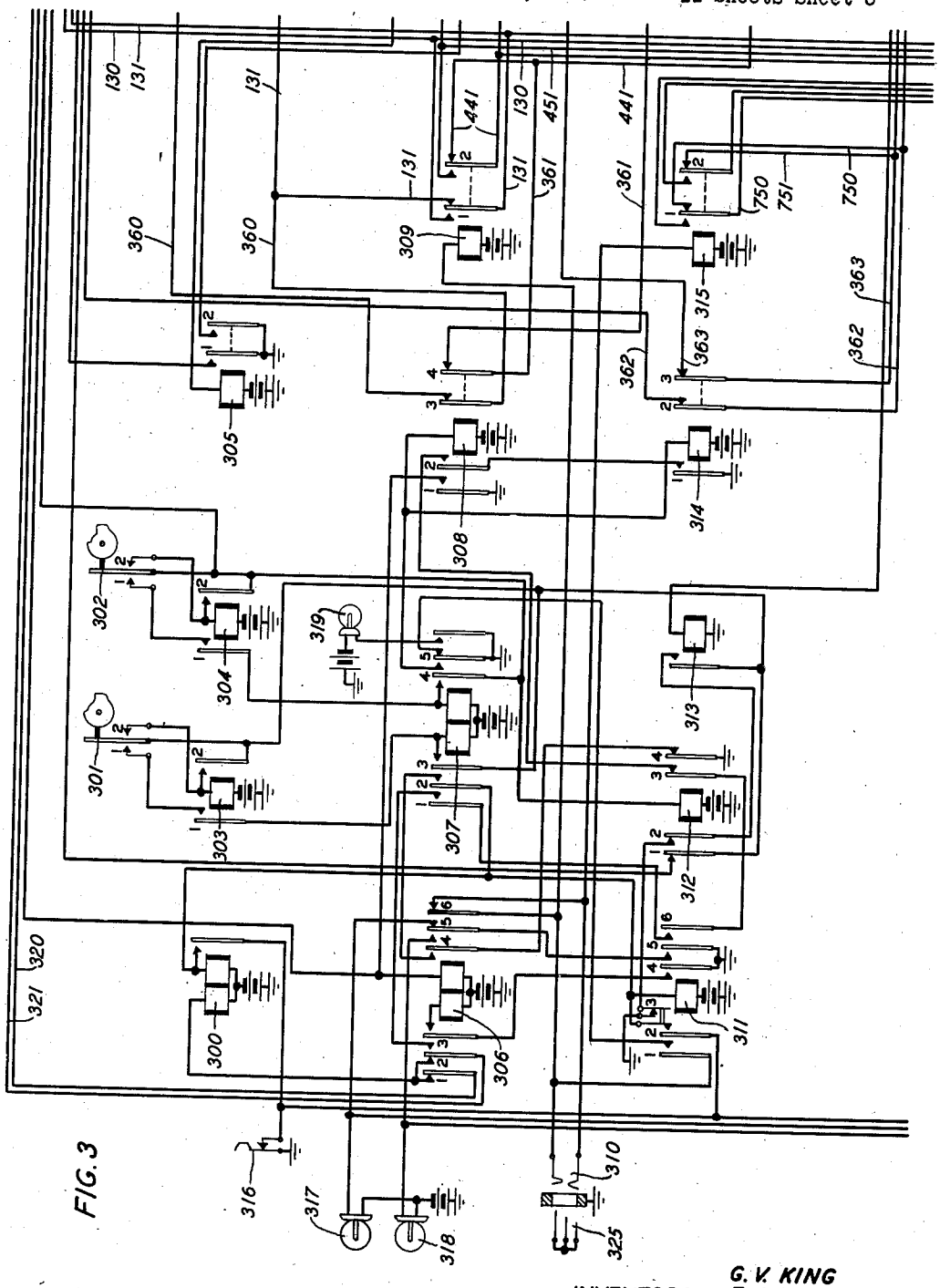

FIG. 3

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TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 4

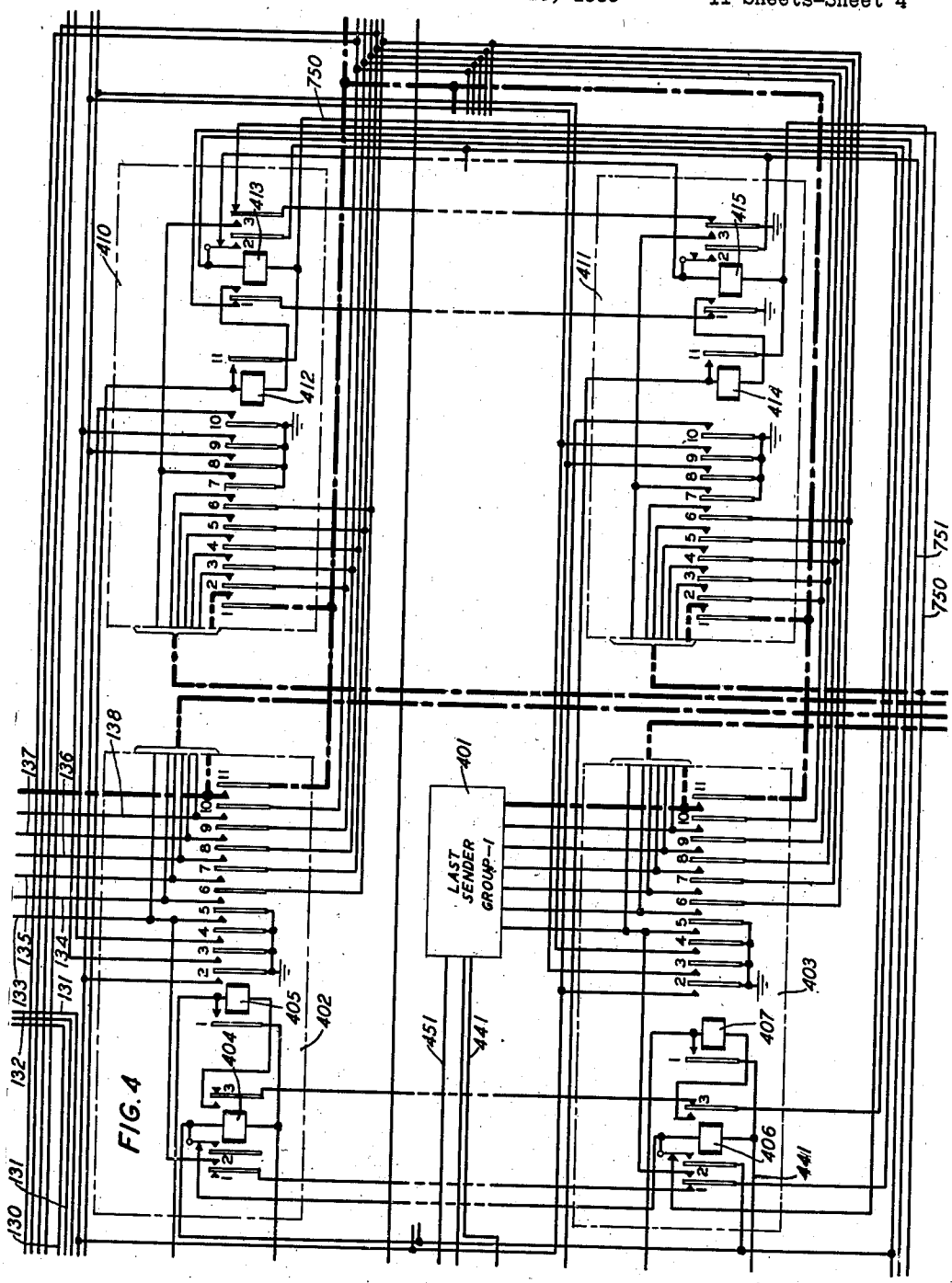

FIG. 4

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TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 5

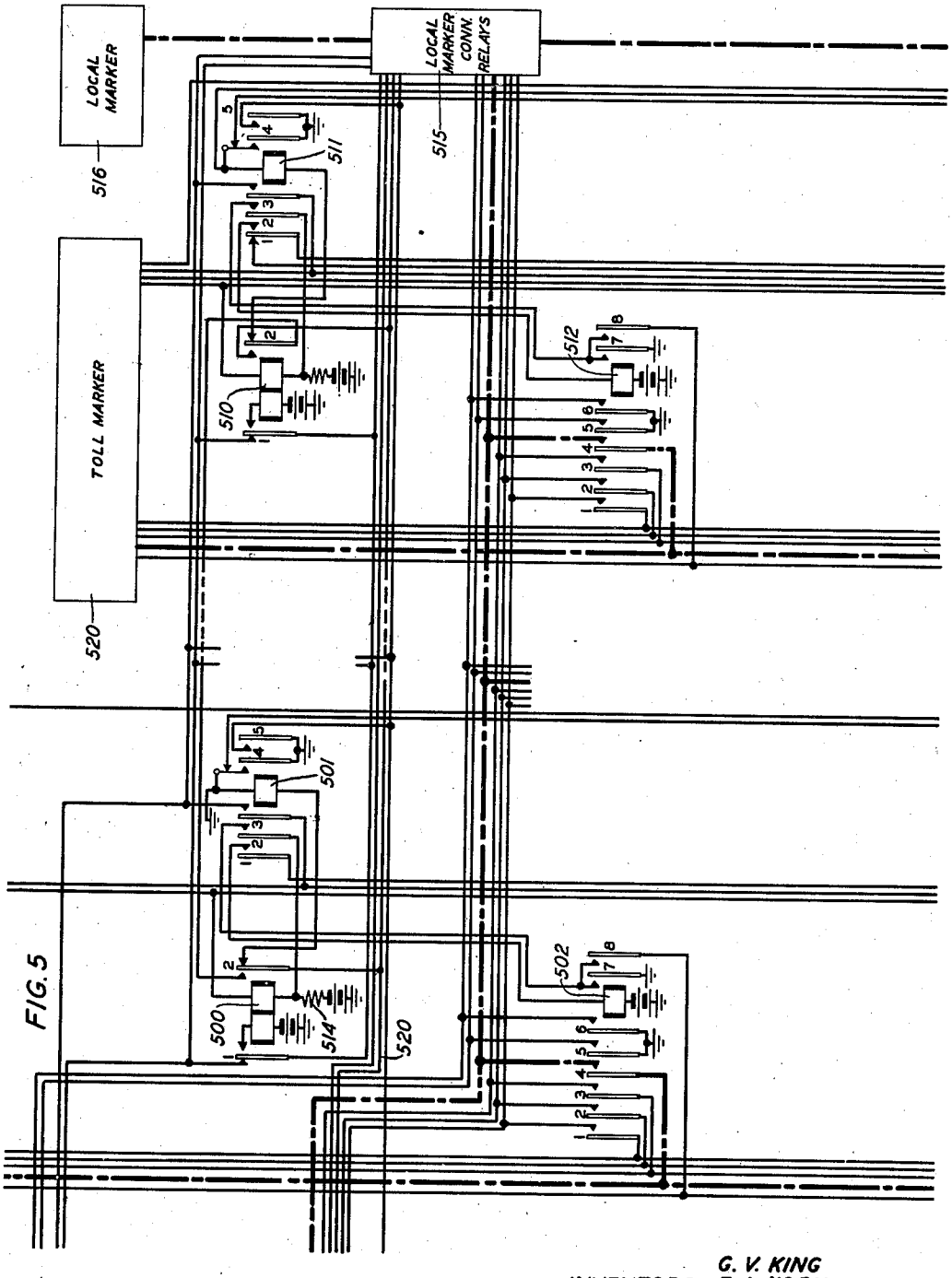

FIG. 5

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TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 6

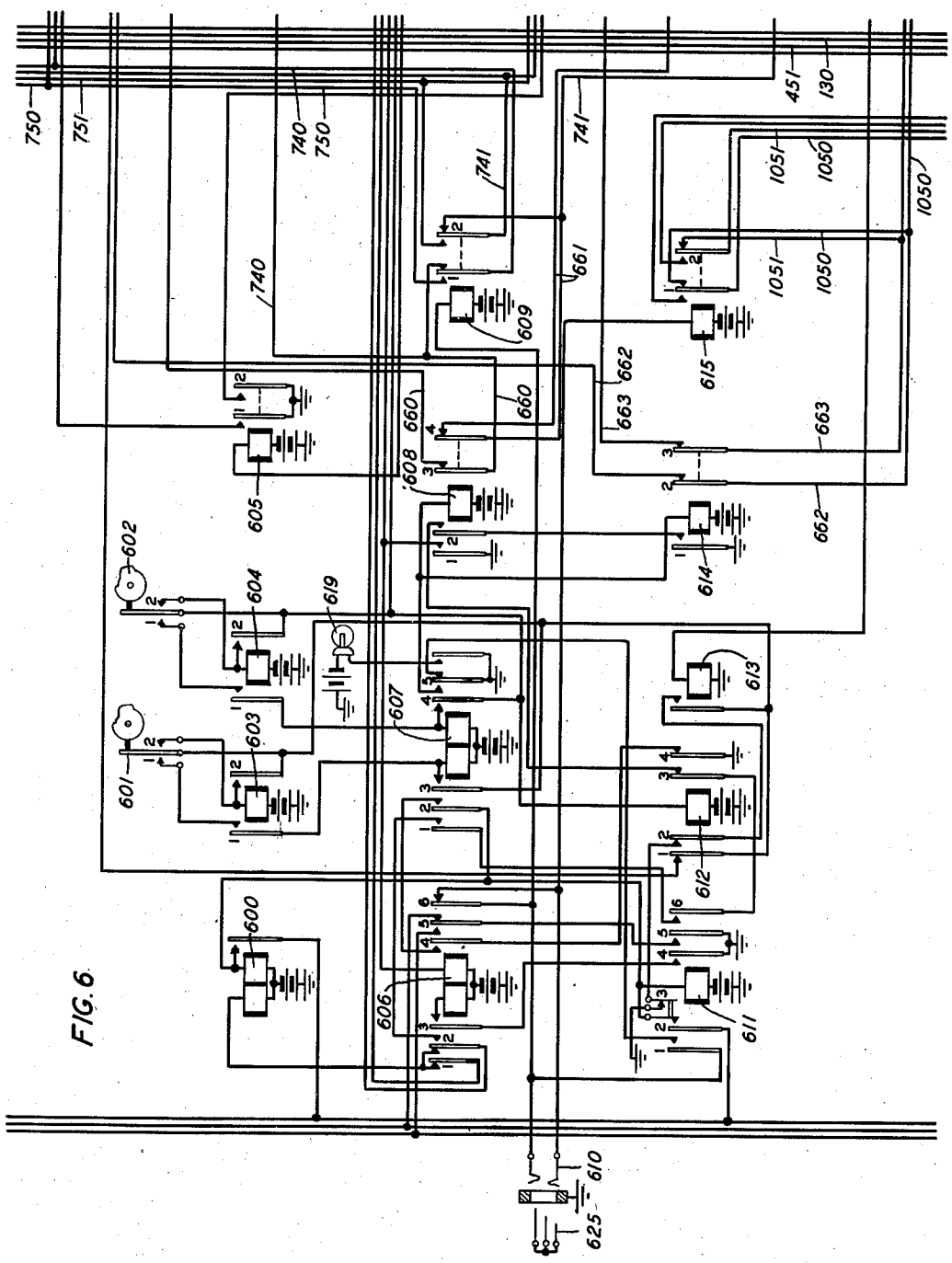

FIG. 6

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TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 7

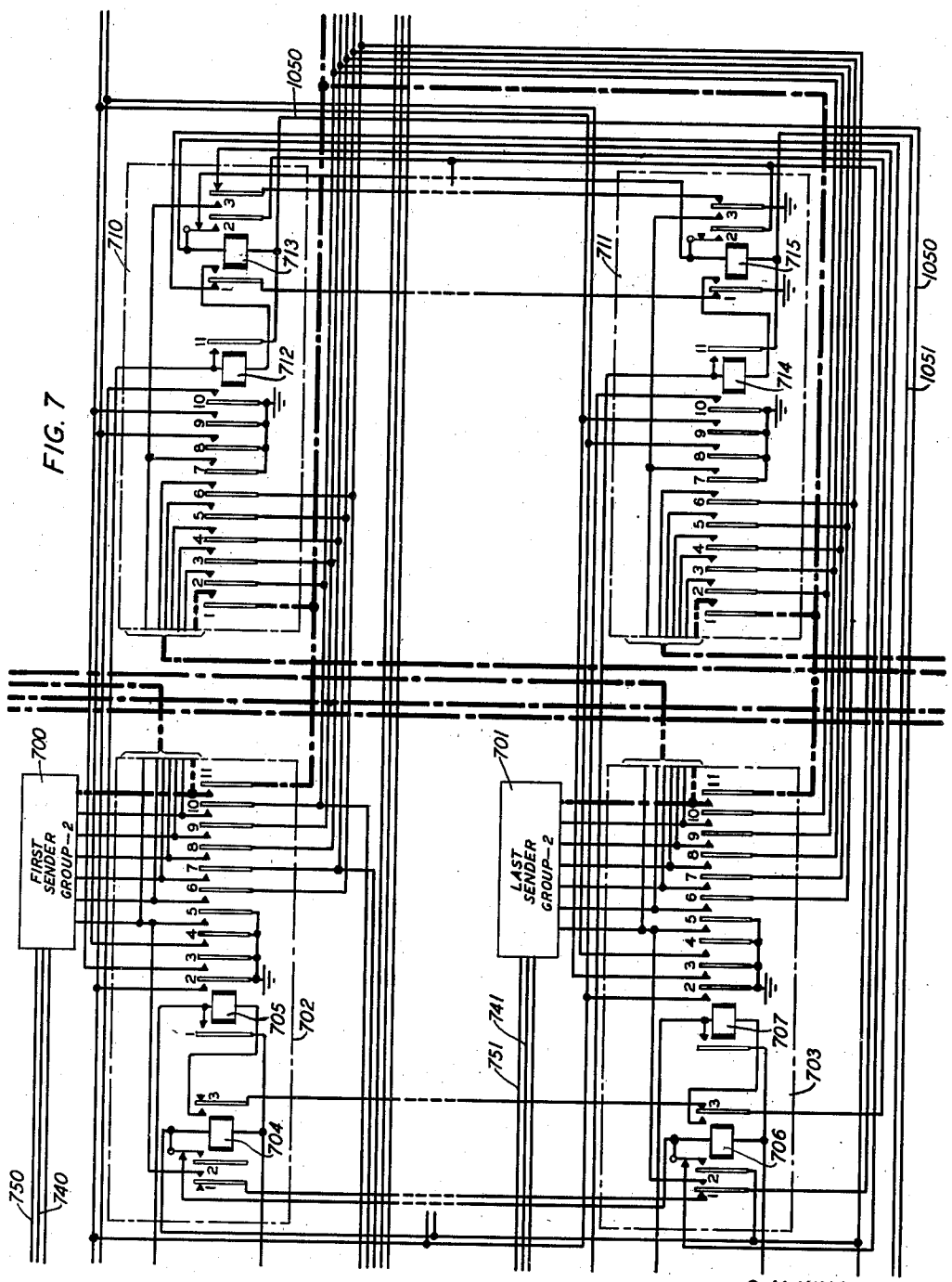

FIG. 7

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TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 8

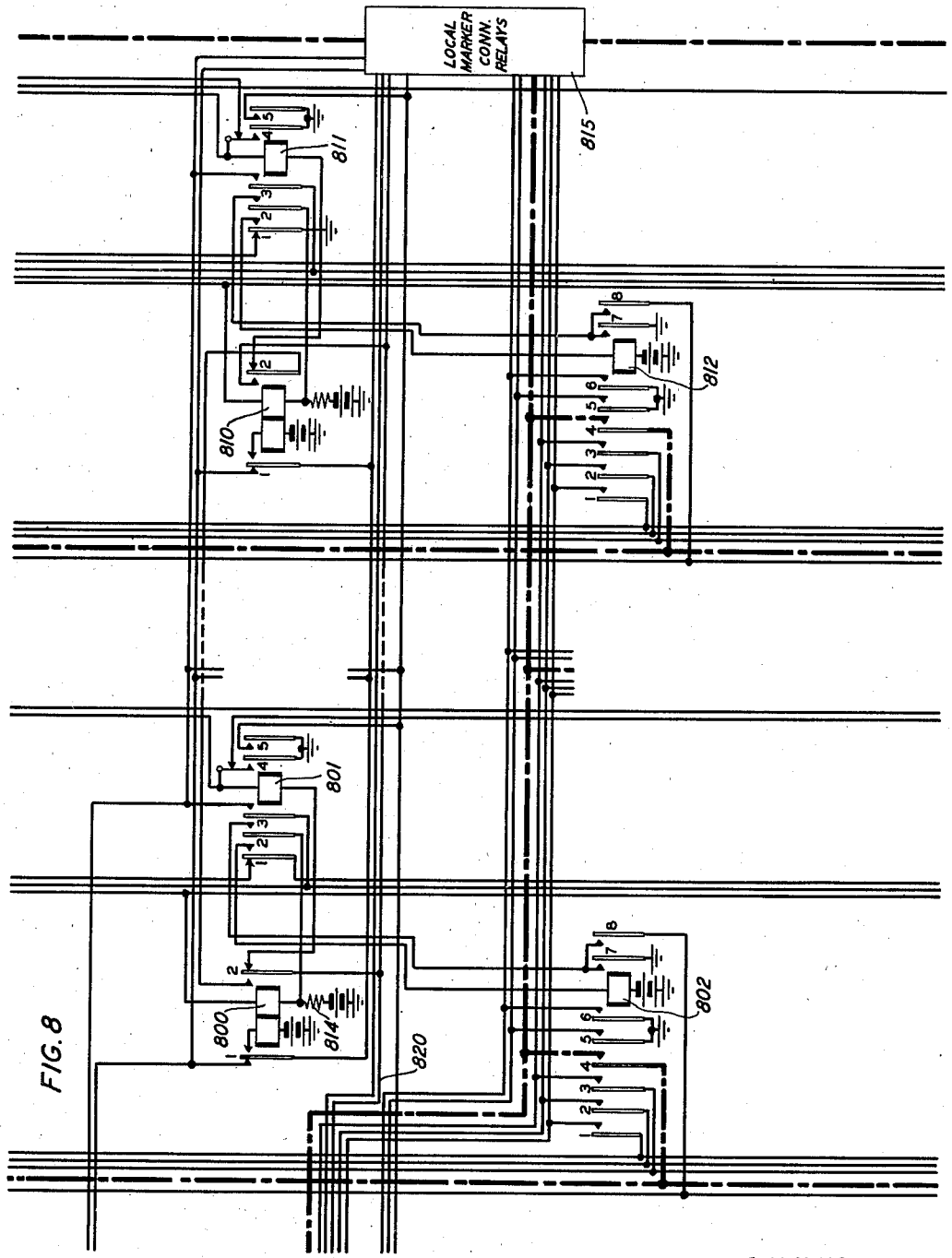

FIG. 8

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May 6, 1941. G. V. KING ET AL 2,241,016

TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 9

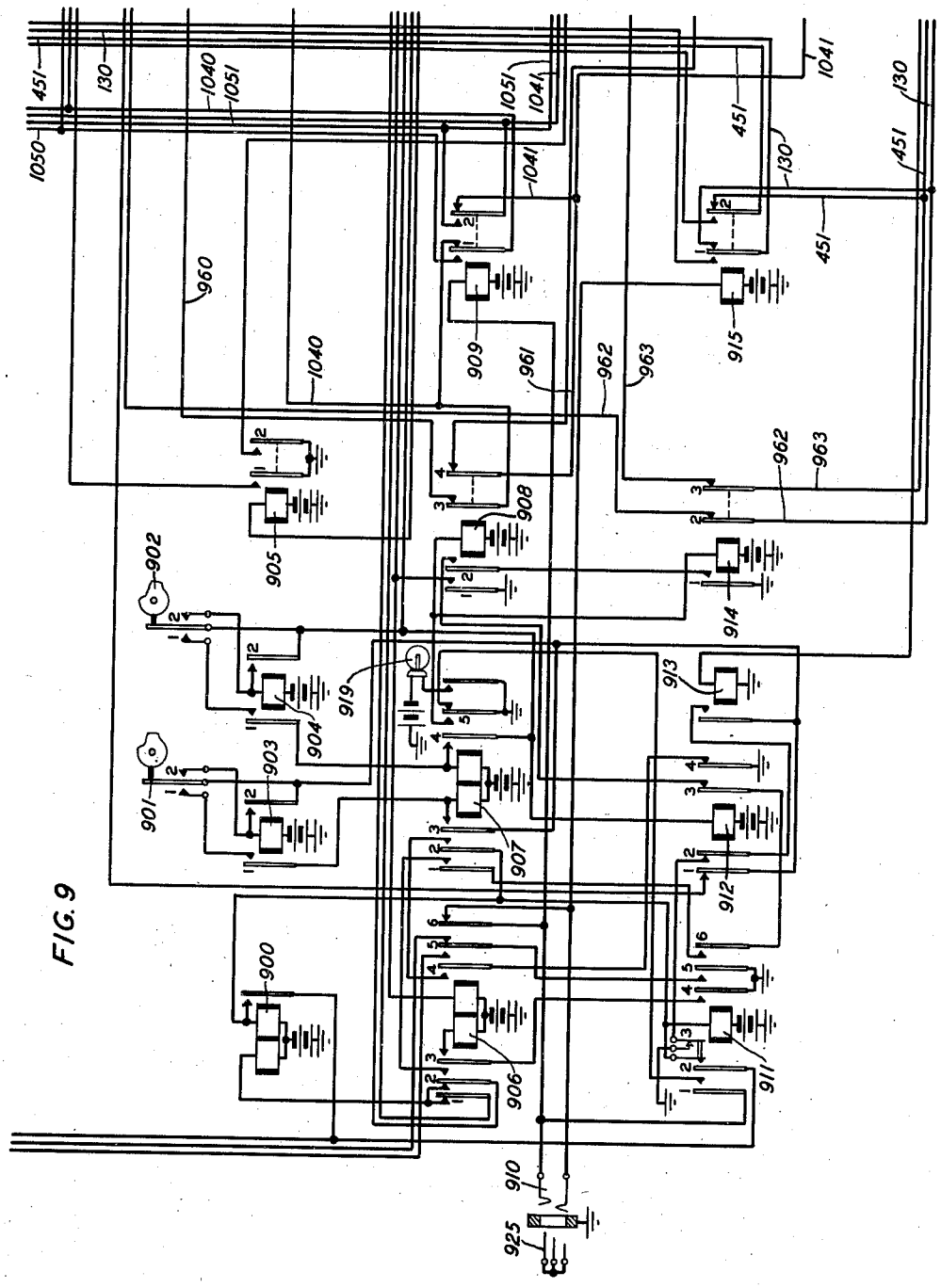

FIG. 9

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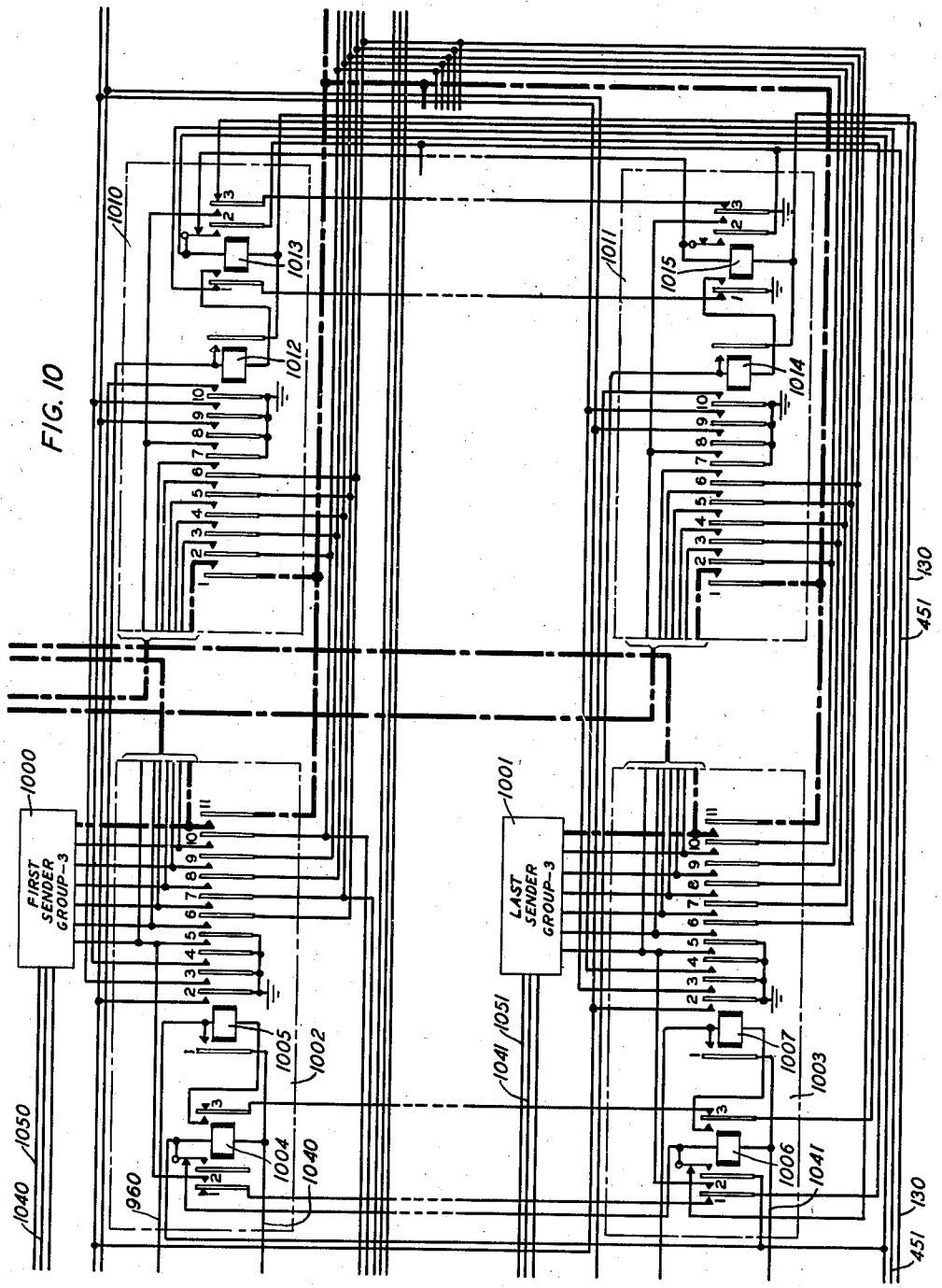
TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 10

FIG. 10



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TELEPHONE SYSTEM

Filed Oct. 19, 1939 11 Sheets-Sheet 11

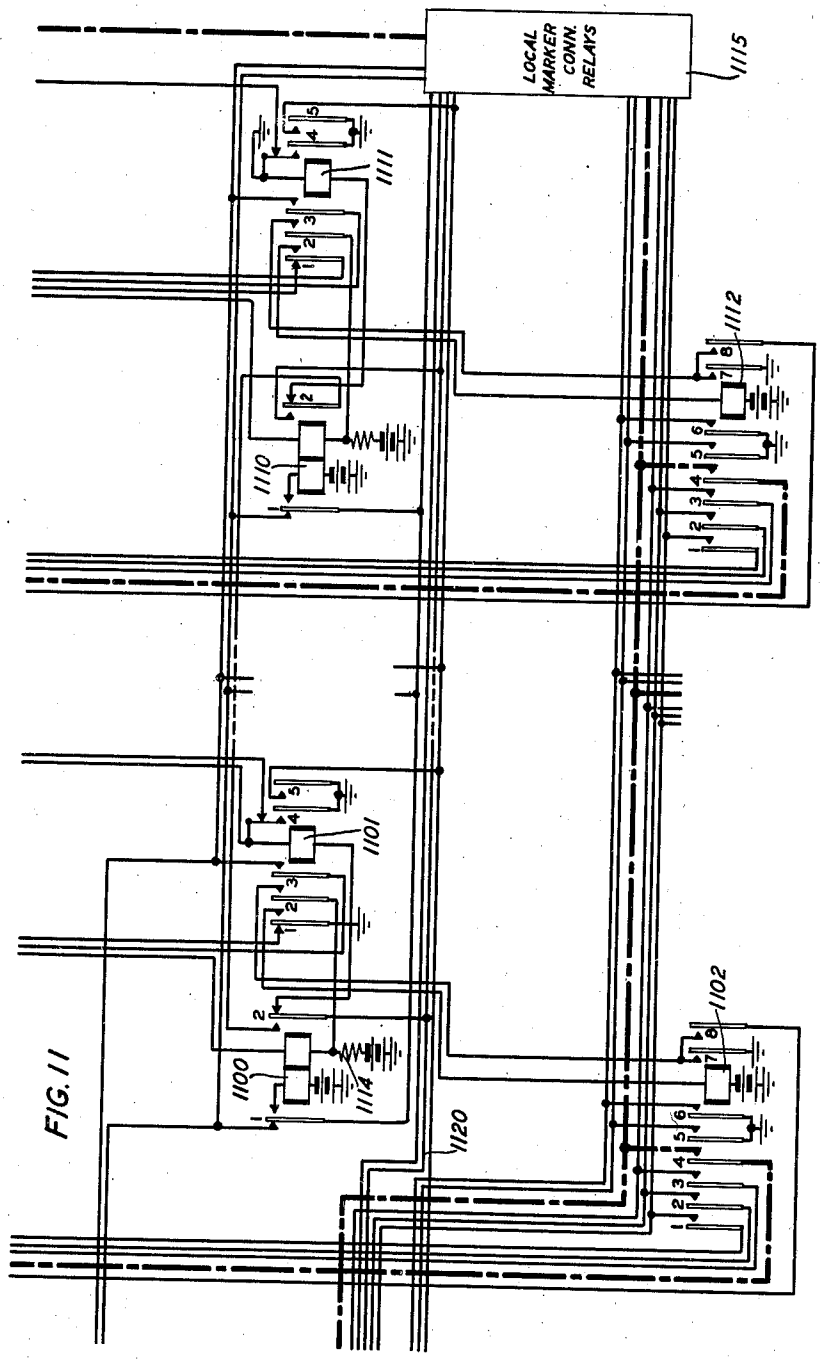

FIG. 11

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Patented May 6, 1941 2,241,016

UNITED STATES PATENT OFFICE

2,241,016

TELEPHONE SYSTEM

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Application October 19, 1939, Serial No. 300,140

20 Claims. (Cl. 179—18)

This invention relates to telephone systems and more particularly to arrangements for automatically connecting a large plurality of conductors from one equipment to another.

Automatically responsive connectors are used in some telephone systems for connecting together two dissimilar types of equipment and extending a large plurality of leads from one equipment to another. Connectors are employed in order that these dissimilar types of equipment may be connected together as required and thus a small number of one type of equipment may successively serve a large number of a different type of equipments. Such arrangements are calculated on a holding time basis per telephone connection. For example, if the average holding time for one equipment is five times as long as the holding time for another equipment, other things being equal, only one-fifth of the latter equipments are required and a connector may be used to connect them together as required.

An arrangement having the above characteristics may be demonstrated in the association of incoming senders with markers. The holding time of incoming senders is comparatively long since, after the sender is seized by a line or an operator, a number of separate operations take place successively. The sender is first operated by pulses or other transmitting devices according to the line connection desired. After the registers of the sender are set a connector is seized and an attempt is made to seize a marker through the actuation of this connector. After the marker is seized registrations are transmitted from the sender to the marker. The marker selects an outgoing trunk corresponding to these registrations and accordingly operates switches for completing the connection and then releases. The incoming sender thereafter may transmit impulses to a distant office or to an outgoing sender through the outgoing trunk which has been selected by the marker. In most cases the marker and connector are released about the time the incoming sender starts to transmit impulses to the distant office or outgoing sender. It may thus be seen that the holding time for the connector and marker is small compared to the holding time for the senders

During busy or overload periods of telephone calls the incoming senders often encounter delays in obtaining the services of a marker since under the present practice a group of incoming senders have access to only one connector between these senders and the group of markers. When a plurality of telephone calls demand the services of a plurality of senders in one group, a connector is seized by the sender first actuated and the other senders in this group which have been actuated must await the completion of the operations in the marker before this connector is released. This not only adds to the holding time of the incoming senders but delays the completing time for telephone connections. In toll telephone practice this delay is particularly serious in view of the added holding time for long and expensive toll lines and equipment involved in such telephone connections. Difficulties may also be encountered in the use of one connector available to a group of equipments such as senders, if for some reason a fault exists in this connector. When this connector is removed from service for test and repair, the group of senders must also be removed from service.

An object of the present invention is to minimize the delay in establishing connections between individual equipments in two groups of dissimilar equipments.

Another object is to enable a connector to be removed from service without disabling the equipments served by the connector.

According to the present invention one connector is used between each of a plurality of groups of equipments and a group of equipments common to said plurality of groups in the same manner as previously practiced. That is: each group having a plurality of equipments therein has a first choice or preferred connector which may be actuated when idle for associating an individual equipment in this group with an individual equipment in the common group. An automatically operable system of apparatus has, however, been provided in each connector so that each connector may be used by the equipments of another group as a second choice or alternate connector when it finds its own first choice or preferred connector busy. By using preferred and alternate connectors according to the invention a connector is found available for use substantially all of the time which accordingly eliminates delays in completing telephone connections.

A feature of the invention is a system having connectors for establishing circuit paths between individual equipments in a plurality of groups of equipments and individual equipments in groups common to the plurality of groups, each group of equipments having one connector which may be seized by an equipment in this group as the first choice or preferred connector for this group or which may be seized by an equipment in another

group as the second choice or alternate connector for this other group.

Another and related feature resides in the circuit arrangement of the individual equipments in said plurality of groups and in the circuit of the connectors which automatically cause the actuation of an associated idle alternate connector when the preferred connector for a group is busy, the alternate connector being the preferred connector of another group of equipments.

Another and related feature is in the automatically responsive action of the system in causing an equipment which has found the regular connector busy and has seized an alternate connector, to abandon the alternate connector if the regular connector becomes idle before the alternate connector has made a connection between two dissimilar equipments.

Another and related feature is a system of associating a plurality of equipments and a plurality of connectors in a sequential order with the equipments having first and second choice access to one connector and the next in order connector, respectively.

Another and related feature is a system of arranging the connectors so that the connector for a group of equipments may be automatically or manually removed from service without removing this group of equipments from service and for establishing the second choice or alternate connector for this complete group of equipments as the first choice connector.

Another and related feature is in the ability of a connector or marker to signal an equipment being served when a connection cannot be completed, the signal causing a responsive adjustment in the circuit of this equipment for seizing the other connector to which it has access. This may be the first choice or the second choice connector depending upon the connector originally seized for completing the connection.

These and other features will be discussed more fully in the following description.

To illustrate the features of the invention reference may be had to the accompanying drawings in which:

Figs. 1 to 11, when arranged as diagrammatically shown in Fig. 12, illustrate three connectors used as first choice or preferred connectors and second choice or alternate connectors between three groups of senders and either a common group of toll markers or a common group of local markers. The detailed structure of one sender in so far as is required for operating the connector is shown in Fig. 1. This sender and sender 401 indicate a plurality of senders forming a group. A second group of senders is shown in Fig. 7 and a third group of senders is shown in Fig. 10. Fig. 2 illustrates the apparatus and circuits of a marker required for completing connections from the connectors and senders.

General description

Three groups of senders, each having a plurality of senders therein are shown in Figs. 1, 4, 7 and 10. The first sender of a group, herein known as group 1 is shown in Fig. 1. The last sender of this group is shown diagrammatically as 401 in Fig. 4. The individual senders of this group are associated with a connector disclosed in Figs. 3, 4 and 5, through a chain circuit which guards against more than one sender being associated with the connector at one time. The connector shown in Figs. 3, 4 and 5 is the first choice or preferred connector serving this group of senders. Each sender of the group may be associated with this preferred connector through the contacts of a multicontact relay, such as 405 or 407. The operation of one such relay connects the conductors of a sender through the connector to either a toll marker or a local marker according to the circuits established in the sender. The apparatus of the connector has differentiating apparatus for selecting an idle marker. Each connector normally prefers a particular marker but if this marker is busy the connector selects another idle marker which may be any marker of the common group of markers. The term "common group of markers" applies herein to either the group of toll markers or the group of local markers. In certain instances one group of markers is used, which is known as a group of combined markers which serves either toll calls or local calls. The first group of senders may also be served by the connector shown in Figs. 9, 10 and 11. This connector is the first choice or preferred connector for the third group of senders 1000 to 1001 and acts in the capacity of the second choice or alternate connector for the first group of senders. For this reason all of the leads from the senders in group 1 are carried through a plurality of multicontact relays 405 to 407 to the preferred connector and 1012 to 1014 to the alternate connector which includes as many multicontact relays in each of the two connectors as there are senders in the group. With this arrangement, sender No. 1 may either be associated with the connector, Figs. 3, 4 and 5, through the operation of the connector start relay 404 and the multicontact relay 405 or associated with the connector, Figs. 9, 10 and 11, through the operation of the connector start relay 1013 and the multicontact relay 1012. The other senders of group 1 are connected in the same manner. For example, the last sender of the group may be associated with the connector of Figs. 3, 4 and 5 through the operation of relays 406 and 407 and associated with the alternate connector by the operation of relays 1015 and 1014. Since each connector prefers a particular marker as first choice the sender would ordinarily be connected to a different marker through the preferred connector than it would through the alternate connector. If, however, in either case the preferred marker is busy connection could be made to the same marker through either connector.

The connector shown in Figs. 6, 7 and 8 is the preferred or first choice connector for the second group of senders diagrammatically shown as 700 and 701 which includes a larger plurality of senders than is shown. The connector start relay 704 and the multicontact relay 705 are actuated by sender 700 for connecting the sender to its preferred connector extending to the group of toll markers, 520 and Fig. 2, or the group of local markers diagrammatically shown as 516. If the preferred connector for sender group 2, shown in Figs. 6, 7 and 8, is indicated as busy the senders of group 2 may be connected to their alternate connector, Figs. 3, 4 and 5, the first sender 700 being connected by the operation of the connector start relay 413 and the multicontact relay 412. Likewise the last and intermediate senders of this group may be connected to the preferred connector by the operation of connector start relay 706 and the multicontact relay 707 or similar relays and to the alternate connector by the operation of connector start relay 415 and the multicontact relay 414 or similar relays. As

previously stated the connector shown in Figs. 9, 10 and 11 is the preferred or first choice connector for the third group of senders which includes first sender 1000, a plurality of intermediate senders not shown and last sender 1001. The connector shown in Figs. 6, 7 and 8 is the alternate connector for this group of senders. The first sender of the group, 1000, may be associated with its preferred connector by the operation of relays 1004 and 1005, and may be associated with its alternate connector, Figs. 6, 7 and 8 by the operation of relays 713 and 712. The last sender 1001 in the third group is associated with its preferred connector by the operation of relay 1007 and associated with its alternate connector by the operation of relays 715 and 714. From the foregoing, it is seen that the connectors are connected in a sequential order with the senders of each group having a first and second choice access to one connector and the next in order connector respectively. This represents one order of arranging the first and second choice access of senders and connectors. Other arrangements are conceivably within the scope of the invention.

The efficiency of the connector arrangement according to the present invention has been calculated according to the holding time for such connectors and the probable time periods when either the preferred connector or the alternate connector are available for serving senders of a group. These calculations were made from actual experience with connectors in use at the present time in which one connector is employed between groups of dissimilar equipments. These calculations show that the connector according to the invention has more than twice the efficiency of the connector now generally in use. Assuming the same delays and the same holding time the connectors arranged according to the invention can handle more than twice the number of calls that the present connectors can handle. Or in other words, the connector will handle the same number of calls with less than half the delay time. It may be seen that this may be calculated from obtaining the over-all time that each connector is used between a sender and a marker coupled with consideration of the periods when a preferred connector is busy and the alternate connector is idle and the overlapping periods when both connectors are used at the same time..

As an example of the efficiency of this connector arrangement, let it be assumed that one sender in sender group 1 is taken for a telephone call and seizes the preferred or first choice connector, Figs. 3, 4 and 5 serving this group and that a second sender in this group 1 is taken for another telephone call. Finding the preferred connector busy but its second choice or alternate connector idle this sender in group 1 is automatically steered to its alternate connector, Figs. 9, 10 and 11 and actuates this connector. This is the preferred connector for the senders in group 3 and if a sender in this group is taken for a telephone call when the connector is serving a sender in group 1 the sender in group 3 is automatically steered to its alternate connector in Figs. 6, 7 and 8. Since the connector in Figs. 6, 7 and 8 is the preferred connector for the senders in group 2 a sender in this group which is taken for use when its preferred connection is thus engaged is automatically steered to its alternate connector, Figs. 3, 4 and 5 which by this time is probably idle. Thus according to calculations the senders of each group will probably have access to either its preferred or alternate connector for completing substantially all telephone calls.

An arrangement is provided for overload conditions whereby a sender finding both the preferred and alternate connectors busy may use the first one to become idle. If more than one sender in a group or groups is awaiting the services of a connector the progressive order of seizure is the order in which the senders attempted seizure of connectors.

From the foregoing it is apparent that connectors according to the invention facilitate the removal of one connector from service, if necessary, without the removal of a group of senders from service. Taking the connector, Figs. 6, 7 and 8, out of service would eliminate this connector as the preferred connector for the senders in group 2 and as the alternate connector for the senders in group 3. The senders of group 2 are, however, now served by their alternate connector, Figs. 3, 4 and 5, and the senders of group 3 are served by their preferred connector, Figs. 9, 10 and 11. The senders of group 1 still have access to their preferred connector, Figs. 3, 4 and 5, and their alternate connector, Figs. 9, 10 and 11.

The alarm and trouble circuits, Figs. 3, 6 and 9, are arranged to automatically switch an individual sender of a group to its alternate connector or switch the complete group of senders to the alternate connector responsive to particular trouble conditions occurring in the associated preferred connector and operate signals to indicate the trouble. A complete group of senders may also be manually transferred to the alternate connector. The connector is thus temporarily removed from service by automatically or manually operable means.

Detailed description

The following detailed description is given for the connectors as associated with incoming trunk circuits, sender circuits and markers in a crossbar system of the character disclosed in patent application King-McKim-Myers Serial No. 295,010, filed September 15, 1939 or the patent application Busch-Scudder Serial No. 295,012, filed September 15, 1939. A connector of this character, however, may be used for connecting together dissimilar groups of apparatus of any character requiring such connection. An incoming call entering a telephone office having equipment therein as disclosed in the aforementioned patent applications, actuates the circuits and apparatus of an incoming trunk circuit. A connection is made automatically from the incoming trunk circuit to a cordless operator's position or incoming sender as fully disclosed in the aforementioned patent application to King-McKim-Myers or to an incoming sender as disclosed and described in the aforementioned patent application to Busch-Scudder. An incoming sender is accordingly seized and the registers of the sender are set according to signals transmitted over the incoming trunk. Such a register is diagrammatically shown as 100 in Fig. 1. The contacts 102 and 103 are contacts on register relays which are connected together on each call over a series circuit through other sender register relays when the sender satisfactorily responds to the signals transmitted. This sender also has a plurality of class relays which are set through the apparatus of the incoming trunk or from an operator's po-

sition to indicate to the sender the character of connection to be established, that is, either a toll connection to a distant toll office or a connection to a local office within the area of the telephone office having the equipment disclosed. If the telephone connection is to be extended to a distant toll office, contact 106 in the class register is closed by the operation of a relay having this contact thereon. This establishes an operating circuit for relay 110 to indicate to the sender that a toll marker is required for completing this connection. The contact 105 is associated with a class relay for operating relay 109 to establish circuits for the selection of a local marker. Relay 114 is operated as a start relay or off-normal relay to establish ground circuit to apparatus of the sender, over a circuit established in the cordless operator's position equipment or automatically established when the sender is seized. The operation of the sender register relays establishes an obvious circuit for relay 113 from battery through its winding over a series circuit through the register relays to ground on contact 2 of the lowest number register relay. Relay 113 establishes a circuit through its contact 1, resistance 116, right winding of relay 115 to a contact on relay 305. The latter relay, when operated, indicates that the associated connector is busy, when normal indicates that the associated connector is idle Each connector has a relay such as 305, 605 or 905, having as many contacts as there are senders in each group associated with the respective connectors. A separate lead, such as lead 132 connected through the right winding of relay 115, is connected from the contacts of relays 305, 605 and 905 to a like relay in each sender. Relay 115 remains normal if relay 305 is normal in the associated connector but operates when it finds this relay operated which indicates that the connector is busy. Leads 130 and 131 traced through the contacts of relay 115 are the start circuits for the preferred and alternate connectors. Lead 131 is the start circuit for the preferred connector, Figs. 3, 4 and 5, which is established when relays 305 and 115 are normal and consequently the connector is idle. Lead 130 is the start circuit for the alternate connector, Figs. 9, 10 and 11, established automatically by the sender and connector when the preferred connector is found busy. Circuits for these leads will be described after other circuit paths have been established in the sender. The operation of relay 113 as previously described, establishes a circuit through its contact 2 for operating relay 107. This circuit may be traced from ground through contact 1 of relay 114, contact 2 of relay 113, contact 1 of either relay 109 or 110, contact 1 of relay 108 to battery through the right winding of relay 107. The operation of relay 107 establishes a circuit from battery through its contact 2, contact 2 of relay 103, contact 2 of relay 118 thence over either leads 136 or 137 depending upon whether a toll marker or a local marker is to be selected. For this example, it may be assumed taht a toll marker is desired and relay 110 was operated through contact 106 of the class register. A circuit is thus established from ground on contact 2 of relay 109, normal, through contact 2 of relay 110, operated, left winding of relay 118 to battery, operating the latter relay. The circuit previously traced from battery through contact 2 of relay 107 is thus extended over conductor 136 to contact 8 of the connector multicontact relay 405. This relay has not as yet been operated and therefore the type of marker to be used will be selected later.

For the first actuation of a connector it will be assumed that the first choice or preferred connector shown in Figs. 3, 4 and 5 is idle and therefore a circuit is not completed for the operation of relay 115. With relay 107 operated the connector is seized over a circuit which may be traced from battery through contact 2 of relay 107, contact 1 of relay 119, contact 2 of relay 108, contact 4 of relay 117, contact 1 of relay 115, normal start lead 131, contact 1 of relay 309, winding of relay 404 to ground through the winding of relay 313. Relays 404 and 313 operate in the circuit traced. Relay 404 establishes a circuit for the multicontact connector relay 405. This circuit extends through a chain of contacts on the start relays such as relay 404 associated with all of the senders of two groups, one group of senders (group 1) having this connector as a preferred or regular connector and the other group of senders (group 2) having this connector as an alternate connector. Relays 404 and 406 are connected with the first and last senders of group 1 with like relays connected to intermediate senders. Relays 413 and 415 are connected with the first and last senders of group 2 with like relays connected to intermediate senders. The circuit for relay 405 may thus be traced from ground on contact 1 of relay 415, normal, through contacts of intermediate relays, contact 1 of relay 413, normal, which are associated with senders having this connector as an alternate connector, thence through contact 3 of relay 406, normal, contacts of intermediate relays, contact 3 of relay 404, winding of relay 405, contact 3 of relay 309, contact 1 of relay 309, lead 131, contact 1 of relay 115, contact 4 of relay 117, contact 2 of relay 108, contact 1 of relay 119 to battery through contact 2 of relay 107.

The operation of relay 405 establishes a locking circuit for itself through its contact 1 and connects all the leads from the sender through its contacts and establishes circuits for the connector relays, Fig. 5, for associating the first sender of group 1 with an idle marker. Ground through its contact 2 is connected to the armature of interrupter 301 for establishing a timing circuit. This timing circuit will be explained later. Ground through contact 5 of relay 405 establishes a shunt for relay 115 of the sender. Assuming that the preferred toll marker is idle the marker preference relay 501 is now operated over a circuit from ground through its winding, contact 2 of relay 500, lead 520, contact 8 of relay 405, lead 135, contact 3 of relay 118, contact 2 of relay 108, contact 1 of relay 119, to battery through contact 2 of relay 107. The same character of relay associated with a local marker would have been operated over lead 137 and contact 9 of relay 405 if relay 118 of the sender remained normal. Relay 501 in operating establishes a locking circuit for itself through its contact 4 to ground and opens the operating circuit for all similar relays 301 and 1101 in other connectors associated with this particular marker. Relay 501 places a busy condition on the connector by establishing a circuit through its contact 5 for busy relay 305. The operation of relay 305 connects a busy ground to all senders associated with this connector. This ground extends to all of the senders in group 1 as shown for sender No. 1 over lead 132 through the winding of relay 115, resistance 116 to contact 1 on relay 113. Any sender of this group attempting to

seize this connector will now operate a relay the same as relay 115 which will cause the actuation of the alternate connector for this group of senders over a start lead the same as lead 130 in a manner to be described later. The operation of relay 501 also establishes a circuit for relay 502 from battery through its winding, contact 1 of relay 501, contact 1 of relay 801, normal, to ground through contact 1 of relay 1101, normal. The operation of the multicontact relay 502 connects the sender leads which have been extended through the multicontact relay 405 to contact of relay 502 and to the apparatus of the marker. This includes conductors extending to the marker registers and the conductors which are shown. The circuits established by contacts 5 and 6 of relay 502 will be covered in the description of the circuit disclosed in Fig. 3. Contact 8 of relay 502 establishes the marker as busy to all other connector circuits by operating relay 203 in the marker. The circuit for this relay may be traced from ground through contacts 7 and 8 of relay 502, winding of relay 203 to battery. The operation of relay 203 establishes a circuit from ground through its contact, right winding of relay 500, resistance 514 to battery. Relay 500 in this connector, however, does not operate since a shunt circuit is placed around this winding of relay 500 from ground through contact 7 of relay 502, contact 2 of relay 501, terminating between resistance 514 and the winding of relay 500. The ground from the contact on relay 203, however, extends through the right winding of relay 800, resistance 814 to battery and the right winding of relay 1100, resistance 1114 to battery associated with the same marker but in other connectors. Since relays 801 and 1101 in the other connectors are not operated no shunt is placed around the right windings of relays 800 and 1100 and, therefore, these relays are operated. With relays 800 and 1100 operated, the circuits for seizing markers in the connectors shown in Figs. 6, 7, 8 and 9, 10, 11 are extended to another marker seizing relay. For example, lead 820 is used for seizing a marker in the connector, Figs. 6, 7 and 8. With relay 800 normal, a circuit is established for marker seizing relay 801 but with relay 800 operated the circuit is extended to marker seizing relay 811 for seizing another marker.

The marker has a timing circuit 210 to guard against failures, operated by the release of relay 205 which is normally maintained operated. The circuit for relay 205 extends through contact 4 of relays 1101 and 801 to ground through contact 4 of relay 501. The operation of relay 501 releases this relay which establishes a circuit for the timing circuit. This may be any well known character of timing circuit such as used for markers which cause the release of the marker or the operation of a trouble indicator when the marker and connector have been maintained in an operated position longer than is required for completing their functions. Relay 207 in the marker is an off-normal relay operated from battery through its winding, contact 3 of relay 501 to ground on contact 3 of relay 405. This relay establishes a locking circuit through its contact 1 to the operating ground and establishes a number of circuits (not shown) for the operation of marker apparatus. A sender thus connected to a marker through the connectors, Figs. 3, 4 and 5, transmits registrations for preparing the marker to select an outgoing trunk in a particular toll group of trunks and for operating the switches to connect the selected outgoing trunk with the calling incoming trunk. Tests assuring the satisfactory operations of the marker establish a circuit for operating relay 208. The operation of relay 208 completes a circuit for operating the marker release relay 202 which opens marker circuits not shown and locks to a plurality of paths to assure the release of all apparatus of the marker. A circuit is also established for relay 119 of the sender for opening the connector start circuit. The operating circuit for relay 119 may be traced from battery through the winding of relay 119, contact 7 of relay 405, contact 2 of relay 502, contact 2 of relay 202 to ground through contact 2 of relay 207. The connector start circuit previously traced over lead 131 is opened by the operation of relay 119 which releases relays 404 and 405 which were held operated to battery from contact 2 of relay 107. The release of relay 405 opens the operating circuit for relay 501 and the locking circuit for relay 207, and both relays release. The release of relay 501 opens the operating circuit for relay 502 and the operating circuit for the connector busy relay 305. The release of relay 305 makes the connector available for seizure by another sender. The marker is not made available for seizure by another connector until relay 202 releases indicating that all apparatus of the marker has been satisfactorily released. Relay 202, as indicated by the dotted line, is maintained operated through a series of contacts of relays which must release before relay 202 can release. Relay 203 is maintained operated through its contact 1 to ground on contact 3 of relay 202 so that this marker will not be seized until it is in proper condition for seizure. The release of relay 501 opened the shunt circuit which maintained relay 500 in a normal position. Relay 500, therefore, now operates to ground on contact 2 of relay 203. Relays 900 and 1100 in the other connectors disclosed also remain operated until relay 203 is released. It is seen that these relays hold the operating circuit for relays 501, 801 and 1101 open so that this marker cannot be taken to use. The release of relay 202 releases relay 203 which opens the operating circuit for relays 500, 800 and 1101, preparing the marker circuit for seizure by any connector. The left-hand winding of relays 500, 800 and 1100, also relays 510, 810 and 1110, are used as for locking the relay in position if a relay, such as 402, is operated before the release of these relays. For example, the locking circuit for relay 500 extends from battery through its left winding and contact 1 to contact 1 of relay 510 to ground on contact 4 of relay 405. This circuit is only established if after relay 205 is released and before the relay, such as 500, is released, the connector is seized for selecting a marker. This selection should proceed to conclusion without interference and therefore the relay remains locked until this marker is made busy. The ultimate operation of the relays, such as 510, associated with another marker in this connector and other connectors releases the holding circuit previously established.

Timing and trouble circuit

The timing and trouble alarm circuit shown in Figs. 3, 6 and 9 associated with each connector functions to guard each operation of the connector so that if any trouble whatsoever is encountered a signal is immediately given to in-

dicate that some part of the connector has a fault therein. As previously stated the seizure of a connector causes the operation of relay 313 in the alarm circuit. The operating circuit for relay 313 is in series with relay 404 or any like relay associated with the plurality of senders in the group of senders which use this connector as a preferred connector and also in the group of senders using this connector as an alternate connector. Each relay 404, 406, 413, 415, 405, 407, 412 and 414 and the intermediate relays connected with the senders of two groups have separate operating circuits through the contacts of relays 308, 309, 314 and 315. The operating circuit for the relays associated with senders using this connector as the preferred connector extends through the contacts of relays 308 and 309. The circuits for relays associated with the senders using this connector as an alternate connector extend through the contacts of relays 314 and 315. The circuits referred to are the same as previously traced for connecting the sender, Fig. 1, with the connector, Figs. 3, 4 and 5. The operation of relay 313 connects ground to the moving member of interrupter 301. This member of the interrupter has a slow movement which allows a maximum time for the operation of the connector apparatus. This interrupter first closes its contact 2 to establish a circuit for relay 303 from battery through its winding, contact 2 and the moving member of interrupter 301, contact of relay 313, contact 2 of relay 312, contact 3 of relay 311 to ground. Relay 303 operates over the circuit traced. After a period of time the interrupter closes its contact 1 which establishes a circuit for relay 307 from battery through its left winding, contact 1 of relay 303, contact 1 of the moving member of interrupter 301, contact of relay 313, contact 2 of relay 312, contact 3 of relay 311 to ground. The operation of relay 307 immediately lights lamp 319 to indicate a fault in the connector and establishes an obvious circuit for operating relays 308 and 314 which opens the operating circuit for connector multicontact relays 405, 307, 412 and 414. If the sender end of the connector circuit functions satisfactorily there is insufficient time for the operation of relay 307 through the contacts of interrupter 301. Assuming that relay 405 was operated satisfactorily, a second circuit is established for the timing interrupter 301 to insure the operation of this timing circuit if relay 313 failed to operate. This circuit may be traced from ground on contact 2 of relay 405, contact 1 of relay 312 to the moving member of interrupter 301. When relay 502 is operated during progressive operations in the connector, a circuit is established for relay 312 and also for interrupter 302. This circuit may be traced from ground on contact 5 of relay 502 to the moving member of interrupter 302 and to battery through the winding of relay 312 operating the latter relay. The operation of relay 312 opens the circuit established for interrupter 301 and starts a second series of timing which replaces the first series of timing events. This is also a slow moving interrupter which allows the maximum time for subsequent operations in the connector and marker. A circuit is first established for relay 304 from battery through its winding, contact 2 and moving member of interrupter 302 to ground on contact 5 of relay 302. If sufficient time elapses the moving member of interrupter 302 makes contact with its contact 1 and establishes a circuit through the right winding of relay 307 which, as hereinbefore stated, establishes a circuit for lamp 319 and a circuit for relays 308 and 314. The operation of relay 307, therefore, serves to indicate either trouble in the connector or that the connector was unable to obtain the services of a marker and also may indicate trouble in the marker which maintained the operation of the connector a longer period than required to complete the normal functions in making a telephone connection. Relay 307 establishes a locking circuit through either winding and the contacts 3 and 4 associated therewith to the ground circuits used for operation through either interrupter 301 or 302.

Second choice or alternate connector

The senders of any group have access to the alternate connectors for completing connections under different and varying conditions. An individual sender of a sender group is automatically transferred to the alternate connector whenever the preferred connector is found busy. An individual sender of a sender group is transferred to the alternate connector under certain conditions when a fault exists in the preferred connector. Under another condition where a fault exists in the connector which makes it impossible to function, a complete group of senders is automatically transferred to the alternate connector and the preferred connector is automatically temporarily removed from service or made unavailable for use. A connector may also be removed from service by a manual operation which transfers all of the senders using this connector as the preferred connector, to the alternate connector.

When the individual sender of a sender group attempts to seize the preferred connector and finds this connector busy the circuits are adjusted to automatically transfer this sender to the alternate connector. As previously stated, a connector is indicated as busy to all of the senders in a sender group by the operation of relay 305 for the connector, Figs. 3, 4 and 5, by relay 605 for the connector, Figs. 6, 7 and 8 and by relay 905 for the connector, Figs. 9, 10 and 11. The operating circuit for relay 305 may be traced from battery through its winding to ground on relay 501. It will be remembered that relay 501 operates for seizing a particular marker through the contacts of the multi-contact relay 502. Assuming that the sender, Fig. 1, attempts to seize the connector, Figs. 3, 4 and 5, when it is busy, a circuit is established for relay 115 from ground through contact 1 of relay 305, conductor 132, right winding of relay 115, resistance 116 to battery through contact 1 of relay 113. The latter relay was operated through the register relay contacts when the sender was actuated. Relay 115 in operating establishes a locking circuit for itself from battery through its left winding and contact 3 to ground through contact 5 of multicontact relay 405, which latter relay is operated since this connector is busy. The operation of relay 115 transfers the start circuit from conductor 131 to conductor 130. The start circuit for the second choice or alternate connector may thus be traced from battery on contact 2 of relay 107, contact 1 of relay 119, contact 2 of relay 108, contact 4 of relay 117, contact 1 of relay 115, lead 130 which extends through Figs. 3, 6 and 9, contact 1 of relay 915, winding of relay 1013, contact 2 of relay 1006, contact 2 of relay 1004, winding of relay 913 to

ground. Relays 1013 and 913 operate in the circuit traced. Relay 913 starts the alarm circuit for timing the operation of the connector, Figs. 9, 10 and 11, as previously described for the alarm circuit, Fig. 3. Relay 1013 establishes a circuit for the multicontact cut-in relay 1012 for associating the first sender, Fig. 1, of sender group 1 with the connector apparatus, Figs. 9, 10 and 11. The circuit for relay 1012 may be traced from ground through contact 1 of relay 1015, contact 1 of relay 1013, winding of relay 1012, conductor 962, contact 2 of relay 914, contact 1 of relay 915 and thence over lead 130 to battery through contact 2 of relay 107 as traced for the operating circuit of relay 1013. A circuit is thus established for the marker preference relay which may be either 1101 or 1111 or an intermediate relay depending upon which of the markers are idle and available for seizure. For this example, it may be assumed that the marker, Fig. 2, is busy, which, as previously described, will cause the operation of relay 1100. If the marker 520 is idle, a circuit is established for relay 1111. A circuit for relay 1111 may be traced from ground through its winding, contact 2 of relay 1110, normal, contact 2 of relay 1100, operated, conductor 1120, contact 4 of relay 1012, lead 136, contact 2 of relay 118, operated, contact 2 of relay 108, normal, contact 1 of relay 119, normal, to battery through contact 2 of relay 107. The operation of relay 1111 establishes an operating circuit for the multicontact marker cut in relay 1112 from battery through its winding, contact 1 of relay 1111, contact 1 of relay 511 to ground on contact 1 of relay 811. The chain circuit through these marker preference relays establishes the fact that no fault exists in the apparatus for seizing this particular toll marker 520. The operation of relay 1112 thus associates the sender, Fig. 1, with the toll marker 520 which may be assumed as the same character of marker as shown in Fig. 2. As previously described, this establishes a circuit for relays 510 and 810 in the connectors, Figs. 3, 4 and 5, and 6, 7 and 8 so that these connectors will not attempt to seize the marker 520. A shunt was placed on relay 1110 so that this relay in the connector being used for seizing this marker, is not operated.

In order that the telephone connection may be completed when a fault is encountered in a connector preceding the seizure of a marker, a signal is transmitted to the sender which adjusts the apparatus of the sender to obtain the services of its alternate connector. This fault may occur in any part of the connector circuits and apparatus up to the operation of the marker cut-in relay such as relay 502. As previously stated the operation of relay 307 from interrupter 301 operates relays 308 and 314 when a fault prevents a connector from completing its function. The operation of relay 308 establishes a circuit for relay 306 from ground on contact 1 of relay 308, right winding of relay 306 to battery. A circuit is thus established for relays 300 and 311. A circuit for these relays may be traced from ground on contact 4 of relay 312, contact 4 of relay 306, contact 2 of relay 307 to battery through the right winding of relay 300 and to battery through the winding of relay 311. Relay 300 is locked to ground on key 316 through its right winding which also establishes a locking circuit for relay 311. A circuit is thus established for relay 108 in the sender from battery through its winding, contact 1 of relay 117, lead 138, contact 10 of relay 405, contact 2 of relay 306, contact 1 of relay 307, contact 6 of relay 311, contact 3 of relay 312, contact 2 of relay 308 to ground on contact 1 of relay 314. The operation of relay 108 opens the operating and holding circuit for relay 107 which releases and causes the release of relays 404 and 405. The release of relay 405 opens the operating ground for relay 108 which also removes a shunt from the operating circuit of relay 117. With this ground removed relay 117 operates in series with relay 108. The circuit for operating relay 117 extends from battery through the winding of relay 108, left winding of relay 117, contact 1 of relay 108, contact 1 of relay 110, contact 2 of relay 113 to ground on contact 1 of relay 114. The operation of relays 108 and 117 changes the start circuit from lead 131 to lead 130. An attempt is now made to seize the alternate connector so that the telephone call may be completed. A locking circuit is established for relay 117 from battery through its right winding and contact 2 to ground on contact 2 of relay 114. The operation of relay 117 establishes a circuit for the reoperation of relay 107 from battery through its right winding, contact 5 of relay 117, contact 1 of relay 110, contact 2 of relay 113, to ground on contact 1 of relay 114. With relays 107, 108 and 117 operated, the start battery is established for the alternate connector start circuit. This start circuit may be traced from battery through contact 2 of relay 107, contact 1 of relay 119, contact 2 of relay 108, contact 3 of relay 117, contact 2 of relay 115, normal, lead 130 which extends through Fig. 3 and Fig. 6 through contact 1 of relay 915, the winding of connector relay 1013, contact 2 of relay 1006, contact 2 of relay 1004, winding of relay 913 to ground. The operation of relay 1013 thus associates the connector, Figs. 9, 10 and 11, with the sender of group 1 as traced and establishes a circuit for the multicontact connector relay 1012. This circuit may be traced from ground on contact 1 of relay 1015 through contact 1 of relay 1013, winding of relay 1012 over lead 962, contact 2 of relay 914, contact 1 of relay 915, lead 130, contact 2 of relay 115, contact 3 of relay 117, contact 2 of relay 108, contact 1 of relay 119, contact 2 of relay 107 to battery. The operation of relay 1012 associates the sender, Fig. 1, with the connector apparatus of Fig. 11 in the same manner as previously described and in the same manner that the operation of relay 405 associated the sender with connector apparatus of Fig. 5. The same operations as previously described may be assumed for this connection and consequently the alternate connector is operated for associating the sender with a toll marker. Relay 1101 is therefore operated from ground on contact 4 of relay 501, contact 4 of relay 801, winding of relay 1101, contact 2 of relay 1100, contact 4 of relay 1012, lead 136, contact 3 of relay 118, contact 4 of relay 117, contact 1 of relay 119, contact 2 of relay 107 to battery. The operation of relay 1101 establishes a circuit for relay 1102 from ground on contact 1 of relay 1101 to battery through the winding of relay 1102. The operation of relay 1102 associates sender, Fig. 1, with the marker, Fig. 2. The subsequent operations in the marker and in the connector are the same as previously described and need not be repeated. It will be remembered that relay 115 is operated by the preferred connector when a sender attempts to seize this preferred connector after it has been taken for use by another sender. The alternate connector start lead is thus actuated

and the latter connector seized if idle. Assuming that this is the first attempt to obtain connection with a marker and a fault is encountered, a circuit is established by the alternate connector for operating relay 108 from ground on relay 914 over a circuit through apparatus of the alternate connector, the same as previously traced from ground on the contact of relay 514 when a fault was encountered in the preferred connector. The operation of relay 108 establishes a locking circuit for relay 115 and releases the apparatus of the alternate connector in the same manner as described for the preferred connector. The shunt is thus removed from relay 117 which operates in series with relay 108 for actuating the preferred connector start circuit. Under normal conditions the latter connector would, after this interval of time, be free for use in completing the connection to a marker and will be seized by the sender and operated in the manner described above.

A complete group of senders may automatically be transferred to the alternate connectors when a particular type of fault is found in a connector. This fault may be either a ground on the connector multiple associated with lead 320 or 321. A ground accidentally associated with either of these leads establishes an operating circuit for group trouble relay 308 which in operating locks through its right winding to ground on key 316. This ground extends through the contact of relay 300, winding of relay 311 to battery which operates relay 311. The operation of relay 311 establishes energizing circuits for connector make-busy relays 309 and 315. A circuit for relay 309 extends from battery through its winding, contact 1 of relay 311 to ground on contact 5 of relay 307. The circuit for relay 315 extends from battery through its winding, contact 6 of relay 306, contact 1 of relay 311 to ground on contact 5 of relay 307. The operation of relay 309 opens all of the start circuits for the first choice connector relays, such as relays 404 to 406, associated with the senders of sender group 1. These start circuits are represented by leads 131 from the first sender in this group and lead 441 from the last sender in this group. These start circuits ordinarily used for actuating the first choice connector, Figs. 3, 4 and 5 are now transferred to leads 130 and 451 extending through the armatures and inside contacts of relay 309, normal contacts of relay 915 for energizing start relays 1013 and 1015 and the intermediate relays whenever the senders of group 1 attempt to seize a connector. Consequently, in this instance the sender in energizing the circuit which would ordinarily actuate the preferred connector establishes a circuit for the alternate connector and does not have any path for energizing the preferred connector. In the sender under these circumstances, the arrangement of transferring from a preferred to an alternate connector is made useless since no circuit is established for energizing relay 115. The operation of relay 315 opens the second choice start circuits 750 to 751 from the senders in sender group 2 to connector start relays 413 to 415 in order to remove this connector as second choice or alternate connector for these senders.

The above condition for transferring a complete group of senders to the alternate connector may also be accomplished manually by the insertion of plug 325 into jack 310 which establishes circuits for relays 309 and 315 from battery through their windings to ground on the sleeve of jack 310. This transfer is made when a connector is removed from service in order that the senders of the group may continue to function in the normal manner using the alternate connector instead of the preferred connector. In this case the senders of group 1 only function through the alternate connector and the senders of group 2 function through their preferred connector during the period of time that this connector is removed from service. Plug 625 is inserted in jack 610 for operating relays 609 and 615 to transfer the senders of group 2 to the alternate connector which in this case is the connector, Figs. 3, 4 and 5. Plug 925 is inserted in jack 910 to operate relays 909 and 915 when the connector, Figs. 9, 10 and 11, is removed from service so that the senders in group 3 may use the alternate connector which in this case is the connector shown in Figs. 6, 7 and 8.

In order to facilitate the tracing of circuits for energizing the apparatus of the preferred connectors or the alternate connectors the following table is given showing the leads to follow for associating either connector with the senders of the different groups. In each case the lead given is associated with battery over a circuit in the sender through a contact, such as contact 2, of relay 107. The preferred connector or the alternate connector is energized in the manner previously described over these leads.

Preferred connector

	Start circuit		Cut-in relay circuit		
	Lead	Relay operated	Lead	Lead	Relay operated
First sender—Group 1	131	404	131	360	405
Last sender—Group 1	441	406	441	361	407
First sender—Group 2	740	704	740	660	705
Last sender—Group 2	741	706	741	661	706
First sender—Group 3	1040	1004	1040	960	1005
Last sender—Group 3	1041	1006	1041	961	1007

Alternate connector

	Start circuit		Cut-in relay circuit		
	Lead	Relay operated	Lead	Lead	Relay operated
First sender—Group 1	130	1013	130	962	1012
Last sender—Group 1	451	1015	451	963	1014
First sender—Group 2	750	413	750	362	412
Last sender—Group 2	751	415	751	363	414
First sender—Group 3	1050	713	1050	662	712
Last sender—Group 3	1051	715	1051	663	714

Under the condition where a sender finds the preferred connector busy and a circuit is established for the operation of relay 115 in order to associate the sender with the alternate connector, the condition may be changed if the preferred connector becomes idle before the relays of the alternate connector are operated. It will be remembered that after the test of the connector is made other operations occur in the sender before the connector start circuit is established. This causes a short interval of time during which the preferred connector could have become idle. When relay 115 is operated to automatically steer the sender to the alternate connector a locking circuit is established through contact 3 of relay 115 to ground on contact 5 of relay 405 in the busy connector. This, of course, applies to any sender of any group as well as any connector, the circuit being the same in all senders and in all connectors. If the con-

nection proceeds to the seizure of the alternate connector a locking circuit is established in the alternate connector for relay 115. Since the connector shown in Figs. 9, 10 and 11 is the alternate connector for the sender shown in Fig. 1, this locking circuit may be traced to ground on contact 7 of relay 1012 this relay being operated for use as the alternate connector. If, however, preceding the operation of relay 1012 the connector, Figs. 3, 4 and 5, becomes idle, relay 405 is released and thus there is no locking circuit for relay 115 and, further, there is no operating circuit for relay 115 since relay 305 has been released. In this case relay 115 releases and a circuit is established for seizing the preferred connector, Figs. 3, 4 and 5, and the circuits to the alternate connector, Figs. 9, 10 and 11, are opened. It may be seen, however, that if the circuit connection is established for relay 1012 the alternate connector is used even though the preferred connector becomes idle a moment after the operation of relay 1012 since the operation of this relay establishes the aforementioned locking circuit for relay 115.

Marker

When, for some reason, the marker, Fig. 2, can not complete its operations according to the registrations, the timing circuit 210 operates the second trial relay 206. This relay connects ground to a lead extending through contact 4 of the connector multicontact relay 502, 802 or 1102. Assuming that this circuit was established through contact 3 of relay 502 it thus extended through contact 10 of relay 405, contact 1 of relay 117, winding of relay 108 to battery. Relay 108 operates in the circuit traced and the operation of relay 108 opens the start circuit for the connector and the operating circuit for relay 107 which releases. Relays 405 and 404 release which causes the release of relays 501 and 502. The ground circuit for operating relay 108 is thus opened which removes a shunt path for relay 117. The latter relay now operates in series with relay 108 from battery through the winding of relay 108, left winding of relay 117, contact 1 of relay 108, contact 1 of relay 110, contact 2 of relay 113 to ground on contact 1 of relay 114. The operation of relays 108 and 117 reestablishes the circuit for relay 107 from battery through its right winding, contact 5 of relay 117, contact 1 of relay 119, contact 2 of relay 113 to ground on contact 1 of relay 114. The operation of relay 107 now establishes a start circuit for the alternate connector which may be traced from battery through contact 2 of relay 107, contact 1 of relay 119, contact 2 of relay 108, contact 3 of relay 117, lead 130, contact 1 of relay 915, winding of relay 1013 in the alternate connector, contact 2 of relay 1006, contact 2 of relay 1004, winding of relay 913 to ground. The alternate connector is thus energized to seize a marker in an effort to complete the telephone connection which could not be completed by the marker originally seized. Under this condition if the alternate connector is busy relay 115 is operated and the sender would make its second choice over the preferred connector since the operation of relay 115 alters the choice of connectors as previously described. Conversely, if the alternate connector has been chosen for the first trial, sender relay 115 was operated for energizing this connector to associate a marker therewith in an attempt to select an outgoing trunk and complete a switching connection. Assuming that this connection cannot be completed because of a fault in the marker or associated equipments, a circuit is established by the marker for signaling the sender to make a second trial as outlined above. This circuit operates the sender relay 108 as previously explained, which establishes a locking circuit for relay 115, releases the connector relays by removing the alternate connector start circuit. Relay 117 is operated as soon as the connector shunt ground is removed from its left winding and relay 107 is again operated to reestablish the connector start circuit for actuating the preferred connector from battery through contact 2 of relay 107, contact 1 of relay 119, contact 2 of relay 108, contact 3 of relay 117, contact 2 of relay 115 to lead 131 which extends to the preferred connector relays as previously traced.

The apparatus for associating a sender with a local marker is the same as shown in Figs. 5, 8 and 10 and is thus diagrammatically shown at 515, 815 and 1115 since it is believed unnecessary to duplicate the disclosure of the circuit and apparatus involved for associating a sender with a local marker. As hereinbefore stated a local marker is seized when relay 109 is operated and relay 110 remains normal. This causes relay 118 to remain normal and therefore the circuit for the marker preference relay, such, for example, as relays 502 and 511, which are in the selecting circuit of the connector for selecting a local marker, is established over lead 137 instead of lead 136. This may be traced from battery through contact 2 of relay 107, contact 1 of relay 119, contact 2 of relay 108, contact 3 of relay 118, normal, lead 137, contact 9 of relay 405 which extends to the local marker connecting relays 515, for operating a relay the same as relay 501. The same action takes place in seizing a local marker as described for seizing a toll marker, that is, a multicontact relay, such as 502, is operated and the busy relays, such as 500, 800 and 1100, function in the connectors the same as described when they are associated with a toll marker.

What is claimed is:

1. In a control system for establishing electrical circuit paths, a plurality of groups of individual electrically operable equipments, each group comprising a plurality of said equipments, another group having a plurality of individual electrically operable equipments therein, connectors for establishing circuit paths between individual equipments of said plurality of groups and individual equipments in said other group, the number of connectors being equivalent to the number of groups in said plurality of groups, and means in the equipments of said plurality of groups automatically energized by means in said connectors for controlling the choice of a connector for completing circuit paths between said individual equipments.

2. In a control system for establishing electrical circuit paths, a plurality of groups of individual electrically operable equipments, each group comprising a plurality of said equipments, another group having a plurality of individual electrically operable equipments therein, connectors for establishing circuit paths between individual equipments of said plurality of groups and individual equipments in said other group, the number of connectors being equivalent to the number of groups in said plurality of groups, means in the equipments of said plurality of groups automatically energized by means in said connectors for controlling the choice of a con-

nector for completing circuit paths between said individual equipments, and means in the connector automatically energized by the individual equipments of said other group for controlling the selection of an individual equipment in said other group.

3. In a control system for establishing electrical circuit paths, a plurality of groups of individual electrically operable equipments, each group comprising a plurality of said equipments, another group having a plurality of individual electrically operable equipments therein, connectors for establishing circuit paths between individual equipments of said plurality of groups and individual equipments in said other group and means in each connector for operatively associating it with the equipments of either of two groups in said plurality of groups, the connectors being so related to the equipments in said plurality of groups that the equipments of one group have first and second choice access to two connectors, said first choice connector for said one group being a second choice connector for the equipments of a different group and the second choice connector for said one group being a first choice connector for another different group.

4. In a control system for establishing electrical circuit paths, a plurality of groups of individual electrically operable equipments, each group comprising a plurality of said equipments, another group having a plurality of individual electrically operable equipments therein, an odd numbered plurality of connectors for establishing circuit paths between individual equipments of said plurality of groups and individual equipments in said other group, and means to operate each connector as first choice for the individual equipments of one group in said plurality of groups and second choice for the individual equipments in another group of said plurality of groups.

5. In a control system for establishing electrical circuit paths, a plurality of groups of individual electrically operable equipments, each group comprising a plurality of said equipments, another group having a plurality of individual electrically operable equipments therein, connectors for establishing circuit paths between individual equipments of said plurality of groups and individual equipments in said other group, the number of connectors being equivalent to the number of groups in said plurality of groups, said connectors being arranged for first and second choice selection by the individual equipments of said plurality of groups, and means in a connector operated by the seizure of said connector by an individual equipment of a group for energizing means in a second individual equipment of said group attempting to seize this connector, for adjusting said latter equipment to make a second choice selection to obtain the service of a connector.

6. In a control system for establishing electrical circuit paths, a plurality of groups of individual electrically operable equipments, each group comprising a plurality of said equipments, another group having a plurality of individual electrically operable equipments therein, connectors for establishing circuit paths between individual equipments of said plurality of groups and individual equipments in said other group, the number of connectors being equivalent to the number of groups in said plurality of groups, said connectors being arranged for first and second choice selection by the individual equipments of said plurality of groups, means in a connector operated by the seizure of said connector by an individual equipment of a group for energizing means in a second individual equipment of said group attempting to seize this connector, for adjusting said latter equipment to make a second choice selection to obtain the service of a connector, said latter connector being the first choice selection connector for the individual equipments of another group and means in said latter connector when so taken for use for energizing means in an individual equipment of the latter group attempting to seize this connector, for adjusting the equipment in said latter group to make a second choice selection to obtain the service of a connector.

7. In a control system for establishing electrical circuit paths, a plurality of groups of individual electrically operable equipments, each group comprising a plurality of said equipments, another group having a plurality of individual electrically operable equipments therein, connectors for establishing circuit paths between individual equipments of said plurality of groups and individual equipments in said other group, the number of connectors being equivalent to the number of groups in said plurality of groups and means in the equipments of said plurality of groups automatically energized by means in said connectors for controlling the choice of a connector for completing circuit paths between said individual equipments, and means in a connector which is energized by a fault for automatically adjusting the equipment connected thereto to cause said equipment to seize another connector for completing circuit paths to an equipment in said other group.

8. In a control system for establishing electrical circuit paths, a plurality of devices divided into groups, a plurality of other devices in a common group, and a plurality of connectors for establishing circuit paths between the devices in said plurality of groups and the devices in said common group operatively associated with said plurality of groups in a sequential order, each device in said plurality of groups having first and second choice access to one connector and the next in order connector respectively.

9. In a control circuit for establishing circuit paths, a plurality of signal sending devices divided into a plurality of groups, a plurality of control devices common to said groups of signal sending devices, a plurality of connecting links for establishing circuit paths between said signal sending devices and said control devices, each connecting link being operatively connected with the signal sending devices of two of said plurality of groups, each connecting link being preferred by the signal sending devices in a particular group and alternate for the other group to which it is operatively connected, and means in the preferred connecting link cooperating with means in a signal sending device associated therewith for automatically transferring said signal sending device to the alternate connecting link for completing circuit paths to an idle control device.

10. In a control circuit for establishing circuit paths, a plurality of senders divided into a plurality of groups, a plurality of control devices common to said groups of senders, a plurality of connectors for establishing circuit paths between said senders and said control devices, each sender being operatively connectable with two connectors, a separate circuit in each sender for actuating either of the connectors associated there-

with, and means in each connector for determining which actuating circuit of the sender shall be used.

11. In a control circuit for establishing circuit paths, a plurality of senders divided into a plurality of groups, a plurality of control devices common to said groups of senders, a plurality of connectors for establishing circuit paths between said senders and said control devices, each sender being operatively connectable with two connectors, a switching circuit in each sender for switching the sender circuit paths from one connector to the other, and means in each connector for actuating said switching circuit.

12. In a control circuit for establishing circuit paths, a plurality of signal sending devices divided into groups, a plurality of other devices in a common group, a plurality of connecting links for establishing circuit paths between said sending devices and said other devices, means in each connecting link for operatively associating it with either of two groups of sending devices in such manner that each sending device group is served by a preference connecting link and an alternate connecting link, means for removing one connecting link from service, and means for altering the condition of service for the group of sending devices preferring the removed connecting link so that said group of senders prefers its normally alternate connecting link.

13. In a control circuit for establishing circuit paths, a plurality of signal sending devices divided into groups, a plurality of other devices in a common group, a plurality of connecting links for establishing circuit paths between said sending devices and said other devices, means in each connecting link for operatively associating it with either of two groups of sending devices in such manner that each sending device group is served by a preference connecting link and an alternate link so related that the preference connecting link is an alternate connecting link for a different group of sending devices and the alternate connecting link is the preference connecting link for a second different group of sending devices, means for removing one connecting link from service, and means for altering the condition of service for the group of sending devices preferring the removed connecting link so that said group of sending devices prefers its normally alternate connecting link.

14. In a control system for establishing electrical circuit paths, a plurality of groups of individual electrically operable equipments, each group comprising a plurality of said equipments, another group having a plurality of individual electrically operable equipments therein, connectors for establishing circuit paths between individual equipments of said plurality of groups and individual equipments in said other group, means in each connector for operatively associating it with individual equipments in either of two groups of said plurality of groups in such manner that the equipments in each group have a first and second choice of two connectors so related that the first choice connector for one group is the second choice connector for a different group and the second choice connector for said one group is the first choice connector for a second different group, and means for removing a connector from service and for altering the relation of said plurality of groups of equipments and said connectors so that all of said plurality of groups of equipments are served by either a first or second choice connector.

15. In a control circuit for establishing telephone connections, a plurality of senders in each of a plurality of groups of senders, a plurality of markers in a common group for controlling switches, one connector per group of senders for establishing circuit paths between the senders of each group and a marker in said common group, means in each connector for serving one group of senders as a preferred connector and a second group of senders as an alternate connector, and means in the preferred connector for automatically controlling the transfer of a sender to the auxiliary connector when said preferred connector for the group of senders is not available.

16. In a control system for establishing electrical circuit paths, a plurality of individual electrically operable equipments divided into groups, another group having a plurality of electrical equipments therein, a number of connectors for establishing circuit paths between individual equipments in said plurality of groups and individual equipments in said other group, multicontact relays in each connector for operatively associating each connector with any individual equipment in either of two groups in said plurality of groups, means in the equipments of said plurality of groups for operating said multicontact relays, and means in a connector cooperating with an operated multicontact relay therein and with means in an individual equipment for automatically transferring said equipment to a second connector associated therewith and for operating the multicontact relay in the second connector for extending the circuit paths from said individual equipment to an idle individual equipment in said other group.

17. In a control device for establishing circuit paths, a plurality of sending devices divided into groups, a plurality of control devices in a common group, a number of connecting links equivalent to the number of sender groups for connecting circuit paths between said sending device and control devices, each connector comprising multicontact relays operatively associated with each sender in either of two sender groups, and one multicontact relay operatively associated with each control device in said common group, means in each connector cooperating with means in a sender for operating one multicontact relay in either of two connector links for operatively associating said sender with one of said two connectors, and means for operating another multicontact relay in the same connector for operatively associating said sending device and said connecting link with an idle control device.

18. In a control system for establishing telephone connections, a plurality of senders in each of a plurality of groups of senders, a plurality of markers in a group common to the senders of said plurality of groups, a plurality of connectors for establishing circuit paths between the senders in said groups and the markers in said common group, means in each connector operatively connected with the senders of two groups, means in each sender operatively connected with two connectors, means in a sender for choosing a particular connector, means in a connector chosen by a sender for selecting an idle marker for a first trial to control the completion of a telephone connection, means in said marker responsive to an unsuccessful attempt to complete said telephone connection for accordingly signaling said connected sender, means in said sender responsive to said signaling means for directing a

second trial to complete said telephone connection over an associated connector not taken for use on said first trial, means in said latter connector for directing said sender to alter its choice of connectors, and means in the connector taken for use to select an idle marker for a second trial to complete said telephone connection.

19. In a control system for establishing telephone connections, a plurality of senders in each of a plurality of groups of senders, a plurality of markers in a group common to the senders of said plurality of groups, an odd numbered plurality of connectors for establishing circuit paths between the senders in said groups and the markers in said common group, each connector being operatively associated with two different groups of an equivalent plurality of sender groups in a sequential order throughout, giving the senders of each group the services of two connectors, means in each sender for choosing a particular connector, means in a connector chosen by a sender for selecting an idle marker for a first trial to control the completion of a telephone connection, means in said marker responsive to an unsuccessful attempt to complete said telephone connection for accordingly signaling said connected sender, means in said sender responsive to said signaling means for directing a second trial to complete said telephone connection over an associated connector not taken for use on said first trial, means in said latter connector for directing said sender to alter its choice of connectors, and means in the connector taken for use to select an idle marker for a second trial to complete said telephone connection.

20. In a control system for establishing telephone connections, a plurality of senders in each of a plurality of groups of senders, a plurality of markers in a group common to the senders of said plurality of groups, a plurality of connectors for establishing circuit paths between the senders in said groups and the markers in said common group, means in each connector operatively associated with the senders of two groups, means in each sender operatively associated with two connectors, one being a preferred connector for the senders of said group and one being an alternate connector for said group, means in a sender for actuating the preferred connector for connecting the circuit paths from said sender to an idle marker for making a first trial to complete a telephone connection, signaling means operable in said marker responsive to an uncompleted connection, means in said sender responsive to the operation of said marker signaling means for making a second trial to complete said connection, means responsive to the operation of said second trial means for preferring the alternate connector on said second trial, and means in the alternate connector for operating other means in said sender for directing said sender to alter its choice of connectors and again seize the preferred connector for said second trial to complete said telephone connection.

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