

April 8, 1941.

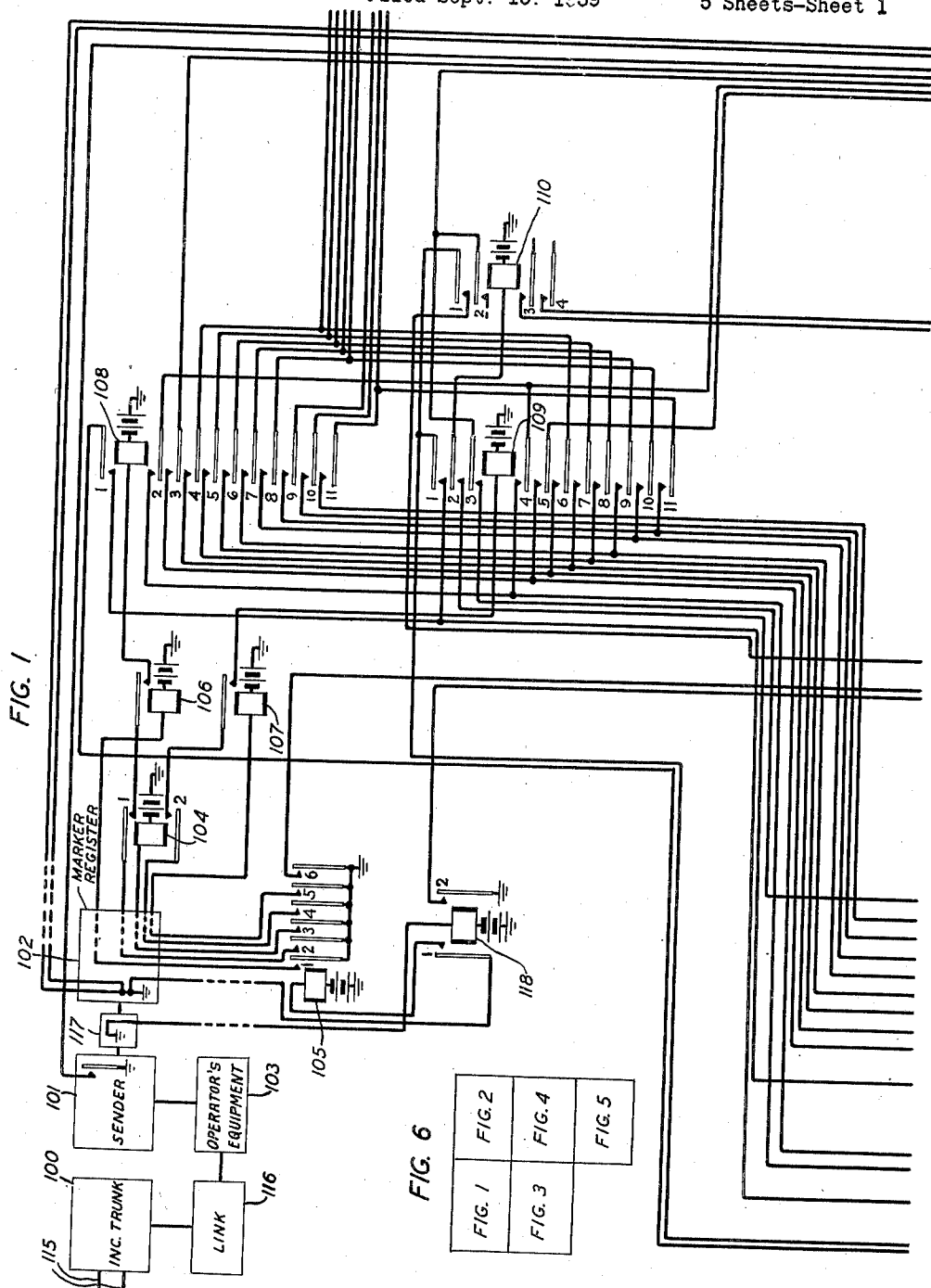
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2,237,906

TELEPHONE SYSTEM

Filed Sept. 15. 1939

5 Sheets-Sheet 1



April 8, 1941.

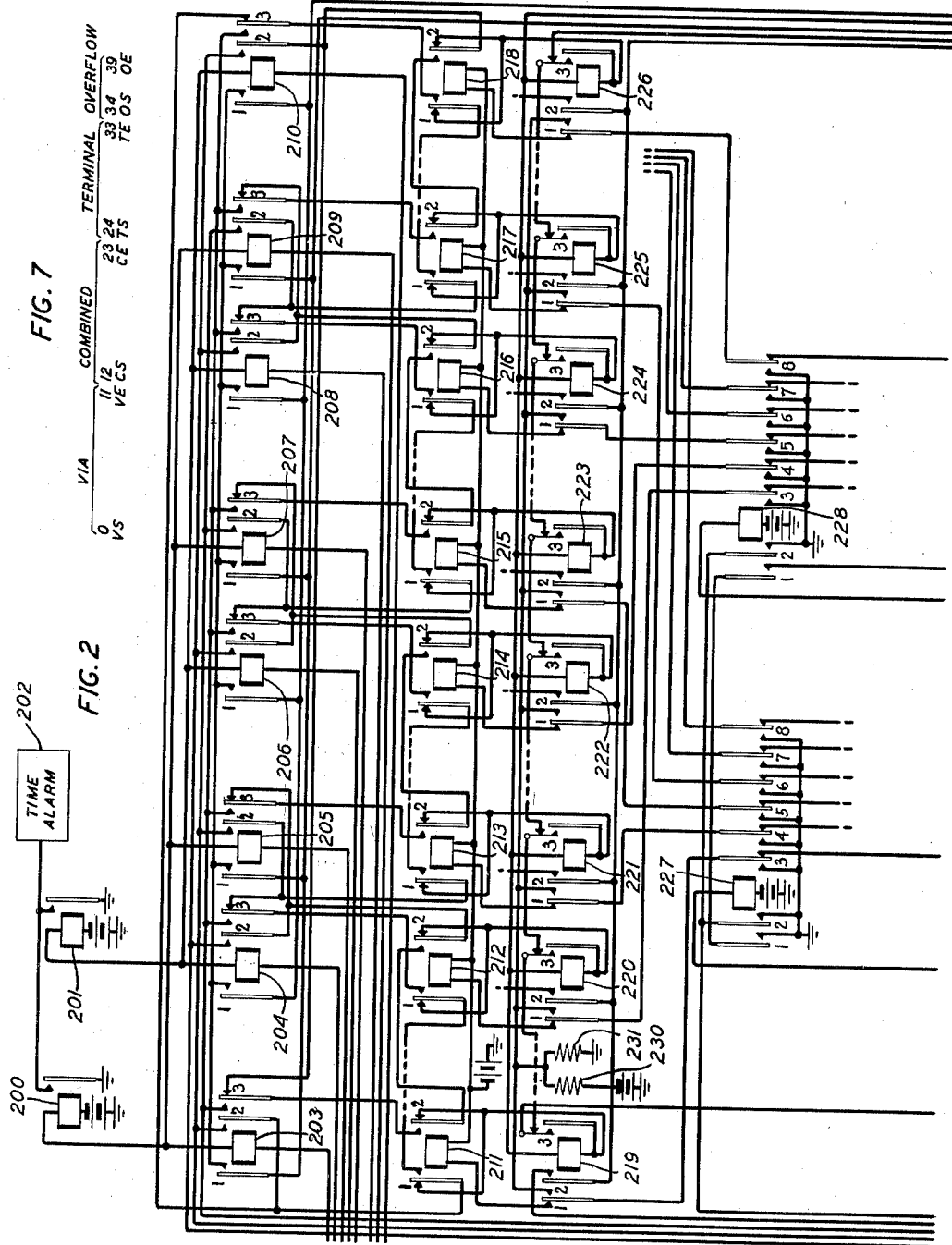
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TELEPHONE SYSTEM

Filed Sept. 15, 1939

5 Sheets-Sheet 2



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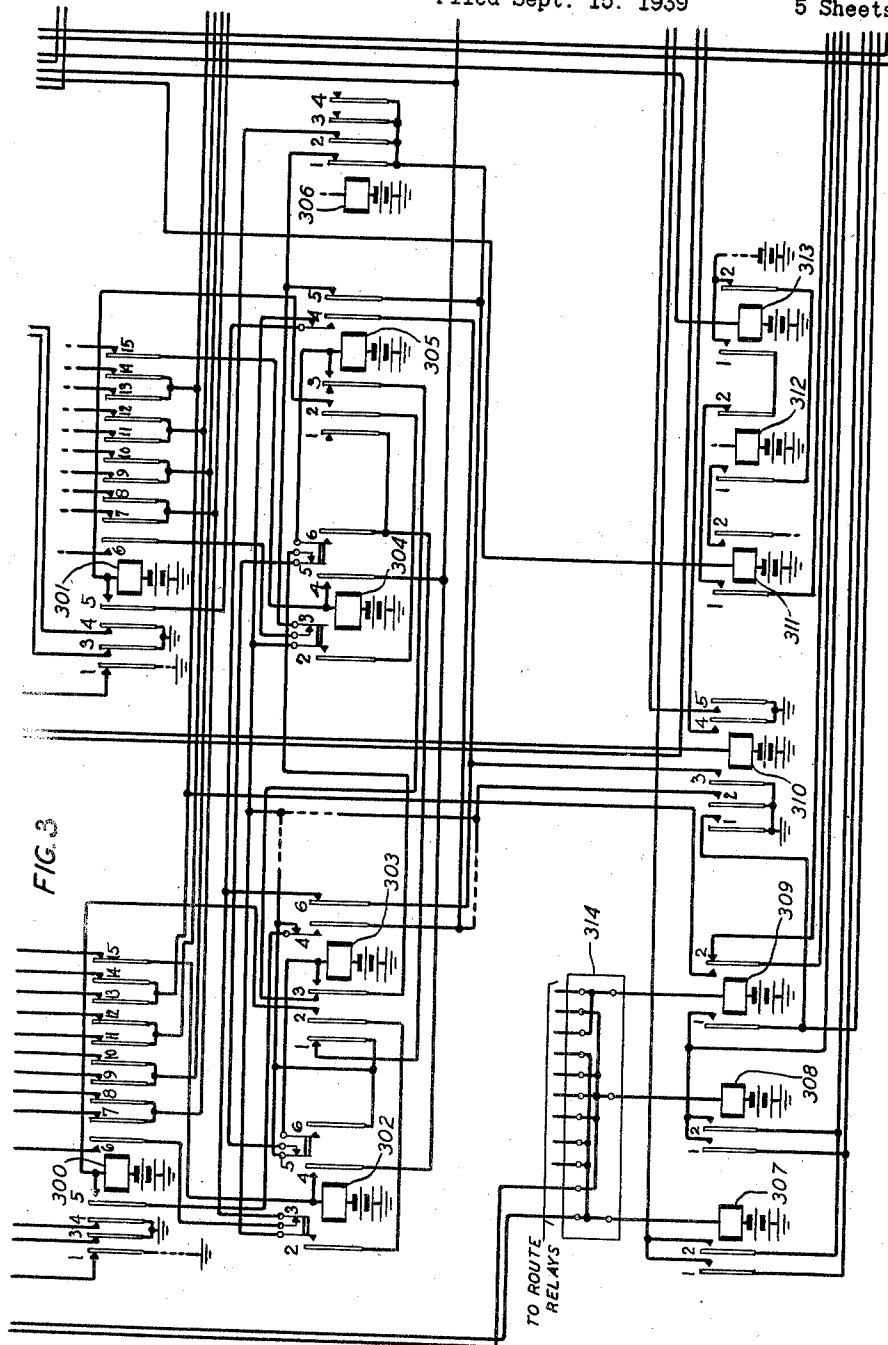
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TELEPHONE SYSTEM

Filed Sept. 15, 1939

5 Sheets-Sheet 3



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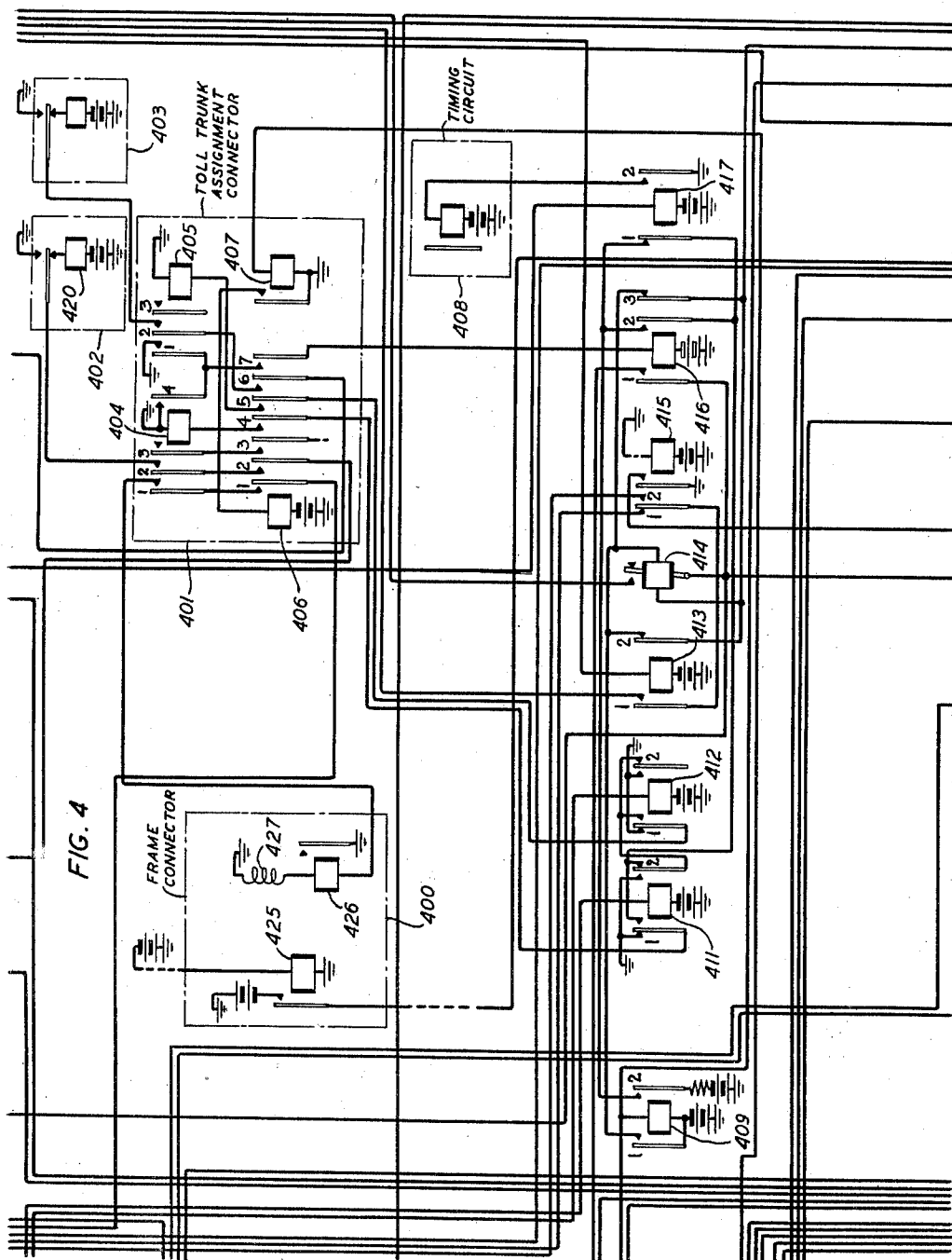
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TELEPHONE SYSTEM

Filed Sept. 15. 1939

5 Sheets-Sheet 4



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April 8, 1941.

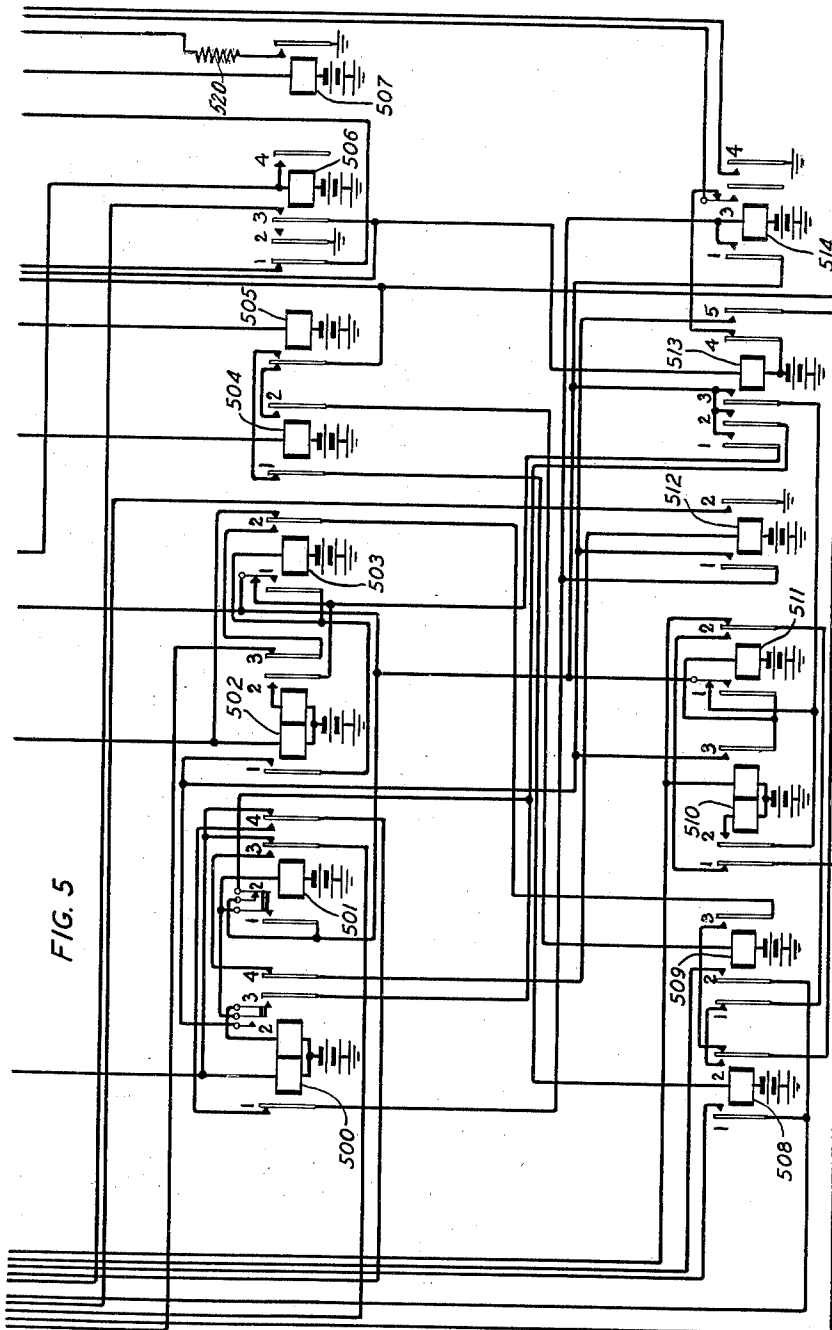
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TELEPHONE SYSTEM

Filed Sept. 15, 1939

5 Sheets-Sheet 5



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2,237,906

TELEPHONE SYSTEM

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Application September 15, 1939, Serial No. 295,011

13 Claims. (Cl. 179—18)

This invention relates to telephone systems and particularly to the selection of idle lines or trunks by means of automatic switching apparatus.

In some automatic switching telephone offices the selection of outgoing trunks and the operation of switches associated therewith is under the control of markers or common controlling devices which have route relays and other associated units of apparatus for directing the test of trunks extending to particular offices and service switchboards. A local telephone office in a large city area has groups of outgoing trunks extending to all other offices within this area with each group under the directional control of a route relay for routing calling lines to an idle outgoing line or trunk within this group. The group may comprise a large number of trunks, for example, two hundred or it may comprise only a small number of trunks such as five or six. A large group, such as two hundred trunks, is divided into subgroups, each subgroup being limited only by the testing facilities of the marker. Testing facilities are provided in each marker for rapidly testing trunks in groups such as twenty or forty which may be subdivisions of a large group of outgoing trunks to a particular office. The trunks of such large groups are all of the same character so that a steering system may be used in combination with a route relay for variably connecting the subgroups of trunks with the testing facilities of the markers. These subgroups may also be connected with the testing facilities of the marker in a successive order by the steering mechanism when all of the trunks tested in a subgroup are found busy.

The present invention is also directed to the testing of subgroups of trunks within a larger group of trunks but in this instance the total number of trunks in the larger group is within the capacity of the testing facilities of the marker, that is, the same or less in number than the subgroup of the aforementioned large group of two hundred. This group which is within the capacity of the testing facilities of the marker may have as many as four small groups of trunks and the trunks of the different subgroups may be of different character.

The route relay used in markers is in all cases a directional routing device for large or small groups of outgoing lines or trunks, a route relay being used for each group of trunks extending to a particular destination. In telephone office areas of the larger cities using this type of equipment there are not many small groups having trunks therein under the capacity of the testing

facilities of the marker and all of the trunks in such groups are of the same character. The expense in providing individual route relays for each of these small groups is therefore not of consequence. However, in other offices, such for example, as toll offices all of the groups of outgoing lines or trunks are comparatively smaller and the manner of providing grouping and routing facilities becomes involved because of the trunks of different character required for different characters of toll telephone connections. Such trunks are necessarily arranged in small groups according to the character of the trunks, for example, a group of trunks extending from one toll office to another may comprise a small group of via intertoll trunks, a small group of terminal intertoll trunks and a small group of combined intertoll trunks. A small group of overflow trunks may be provided in this group when no idle trunks are found in the subgroups tested. The total number of small groups or subgroups within this group may be within the capacity of the testing facilities of the marker and this group of subgroups when placed under the responsive control of registrations from a calling toll line giving the routing and the character of the outgoing trunk required according to this invention, can be placed under the directional control of a single route relay instead of providing a route relay individual to the small groups of trunks of different character.

The object of the present invention is therefore to economize in telephone exchange circuits and equipment ordinarily required in automatic switching offices for completing connections between calling incoming lines or trunks and outgoing trunks of small groups, by associating a plurality of said small groups of trunks of different character with a single route relay for establishing connections to, and controlling the test of, the trunks of said groups, for finding idle trunks of a character registered by a calling line over which telephone connections may be established.

According to the present invention an automatic switching telephone office is provided with a switching system and a plurality of switching system control relays in each marker which are common to the route relays of this marker. After the selection of the marker and registration of the character of outgoing call desired, a particular route relay is operated which may have a plurality of small groups of trunks associated therewith. The operation of the route relay in combination with the relays of the registers es-

establishes circuits for a switching system control relay which controls testing apparatus associated with the route relay. The auxiliary switching system relays cooperate with the marker apparatus for testing trunks under the control of the route relay in such manner that one or more of the small groups of trunks associated with the contacts of the route relay may be tested in an effort to find an idle trunk extending to a destination as recorded in the marker.

A feature of this invention is a recording and switching device in a marker for controlling the test of any of a plurality of small groups of lines or trunks through different sets of contacts of a single route relay.

Another and related feature of this invention is a recording and switching device in a marker for successively testing a plurality of small groups of lines or trunks of different characteristics controlled through different sets of contacts of a single route relay of said marker under the direction of a recording device and the register of the marker.

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;

Fig. 1 discloses apparatus associated with an incoming line of an automatic switching toll office including a diagrammatic showing of an incoming trunk, a link, a cordless toll operator's position, a toll position sender, and the register of a switch controlling marker. Tens relays, fifties relays, route relays and control circuits of the marker are also shown in this figure of the drawings.

Figs. 2, 3, 4 and 5 illustrate circuits and apparatus of a marker cooperating with the apparatus of Fig. 1 for controlling the selection of idle trunks according to the invention. Fig. 2 includes trunk group and a subgroup testing apparatus. Figs. 3 and 4 include trunk group and subgroup control apparatus and circuits, Fig. 5 the subgroup switching apparatus and circuits.

Fig. 7 illustrates an arrangement of subgroups of outgoing trunks of a group within the capacity of the testing facilities of the marker.

The foregoing figures of the drawings when placed together as shown in Fig. 6 illustrate the detail structure of the invention.

The system chosen to illustrate the features of this invention is in general similar to the one disclosed in the application of King-McKim-Myers, Serial No. 295,010, filed Sept. 15, 1939.

In the present system automatic switches may be used as shown in the above application under the control of common register senders and common markers. The senders and markers for controlling these switches, the manner of connecting the markers to said senders and to the line connecting switches, and the methods whereby these switches are controlled in their selective operations, are in many respects the same as those already known in the art. For a detailed disclosure of an incoming trunk, a cordless operator's position, the associated senders, a link for establishing connection between an incoming trunk and an operator's position and detailed disclosure of a marker, all of which may be used in completing circuits for this invention, reference is made to the above patent application to King et al. The apparatus of this invention may also be associated with marker controlled telephone systems, such as disclosed in the patent to Williams, 1,553,347 of September 15, 1925, and to

the patent to Carpenter, 2,093,117 of September 14 1937, and other telephone systems employing registering devices for completing line connections.

General description

It has been stated that the present disclosure may be associated with a system such as disclosed in application to King-McKim-Myers, Serial No. 295,010, filed Sept. 15, 1939, in which an automatic switching toll system is disclosed. In a system of this character apparatus in an incoming trunk is actuated by signals over an intertoll trunk or line from a distant office. The initial operation in the incoming trunk actuates the apparatus of a link for automatically associating a sender or a cordless toll operator's position equipment with the incoming trunk and consequently with the incoming line from the distant office. The desired connection is transmitted by signals or given to the toll operator by the distant operator and registrations are recorded which actuate the apparatus of a sender, such as sender 101. When the apparatus of the sender is completely set a start circuit is established for associating an idle marker therewith for transferring the registrations of the sender to a registering apparatus of the marker. Various items of information are recorded indicating to the sender and marker the character of the calling incoming line, the destination of the outgoing line desired and the character of the intertoll trunk to be used for extending the call from this toll office to a distant toll office or to an office within the local area of this toll office. Such registrations are made in the marker registers 102 which establish circuits for selecting a particular tens relay and a particular fifties relay which combine to establish a circuit through their contacts for operating a particular route relay. According to the invention the route relay selected may control the test of a plurality of small groups of trunks and these small groups may differ in transmission characteristics. Also they may differ in destination.

Trunk lines extending from one toll office to another are given names which signalize their transmission characteristics. For example, via intertoll trunks or lines may be used for extending a call via a plurality of toll offices such as a toll connection involving at least three toll offices as will be the case where a call is made from a subscriber in the Albany area through a toll office in Albany, a toll office in New York city, a toll office in Washington, D. C., to a subscriber in the latter toll area via intertoll trunk lines have a particular transmission characteristic and include equipment not required in trunks which may be used for toll calls which originate in one toll office and terminate in the next distant toll office. The latter trunks are known as terminal intertoll trunks. It is to be understood that while the character of the via and terminal intertoll trunks is different, the quality of transmission over these trunks in the manner used, is substantially the same since the losses encountered in the via connection are not encountered in a terminal connection. Other intertoll trunks are known as combined trunks and have the characteristics of either a via intertoll trunk or a terminal intertoll trunk. A group of trunks extending from one toll office to another toll office may have intertoll trunks of all of the above characteristics. In this case, the combined trunks are used whenever a via trunk or a terminal trunk is required for a call but is not available.

This group of trunks may also include a subgroup of overflow trunks which are used when the trunks of a given characteristic are all busy and the completion of a call must wait for a line of this group to become available. The above small groups within a group are generally known as subgroups and may herein be known as such. According to the invention there may be a plurality of small groups of trunks of as many characteristics occupying the space of one regular group and may be under the control of one route relay.

One registration made in the marker indicates whether a via intertoll trunk or a terminal intertoll trunk is desired for completing a telephone connection. This establishes the preference in the switching circuit shown in Fig. 5 for the subgroup of trunks to be first tested. One of a plurality of pattern or switching circuit control relays is operated through the contacts of the route relay which indicates to the switching circuit of Fig. 5 whether other subgroups of trunks shall be tested if no idle trunk is found in the first subgroup tested and also indicates the successive order of test. The switching circuit establishes connections through the contacts of the route relay which has been operated for marking the limits of the subgroup to be tested within the larger group controlled by this route relay. This is accomplished by establishing circuits for two relays in Fig. 2 indicating where the tests shall start and end. If all of the trunks in this group are found busy a relay is operated responsive to this busy condition which establishes circuits for transferring the testing apparatus from this subgroup of trunks to another subgroup of trunks within the group. The limit of the second subgroup of trunks is then marked by circuits extending through the contacts of the route relay under the control of the switching circuit control relay. This operates a second pair of relays in Fig. 2 indicating the start and end of test in this subgroup. In other words, the number and location of the trunks in the subgroups to be tested may be successively designated by the switching circuit and the switching circuit control relays. If the trunks in this second subgroup are found busy, a relay is again operated responsive to this busy condition for transferring the trunk testing equipment to a third subgroup which may be a group of overflow trunks. A circuit is thus established for marking the start and end of test of the overflow trunks. If an overflow trunk is found idle the calling line is routed to this overflow trunk in the usual manner and a signal is given by the overflow trunk indicating that no trunk is available for completing the telephone connection.

In some instances, a group may be provided with trunks of different characteristics and later enlarged to require more than one route relay. Such an arrangement is shown associated with the route relay 109. The trunks in the subgroups under the control of the contacts of this route relay may all be found busy and an additional route relay, such as 110, may be operated instead of routing the calling trunk to an overflow trunk. The subgroups associated with the secondary relay are tested in the same manner as the subgroups of the original route relay to be operated.

The foregoing general description is supplemented by the following detailed description of the drawings.

Detail description

Let it be assumed that a toll call is initiated

by a subscriber associated with a distant toll office and that the operator in the distant toll office energizes the incoming trunk 100 over intertoll trunk conductors 115. The incoming trunk 100 is diagrammatically shown and may be any character of trunk, such, for example, as a ring-down incoming trunk as shown in the aforementioned patent application of King-McKim-Myers, which extends from a manual toll office to a cordless operator's position in another toll office or it may be an incoming trunk extending from a distant toll office over which pulses are transmitted for designating a desired connection, in which case the incoming trunk is directly connected to an automatically responsive sender in the receiving toll office instead of the cordless position and the sender such as 101 associated with a cordless toll operator's position. For the sake of simplicity in describing the invention, the incoming trunk 100 may be assumed as either a ring-down incoming trunk or a straightforward trunk, either of which is associated with a cordless operator's position, the instructions for completing the telephone connection being given verbally by the distant operator to the cordless toll operator whose equipment is diagrammatically shown as 103. This may be the same as disclosed in detail in the aforementioned patent application to King et al. The calling incoming trunk may be a via intertoll trunk having a high transmission characteristic, a terminal intertoll trunk used for a call to a subscriber in the area of the receiving toll office, or a combined trunk having the characteristics of a via intertoll trunk and a terminal intertoll trunk.

A signal transmitted over the trunk conductors 115 actuates apparatus in the incoming trunk 100 which energizes a start circuit for a link 116 associated therewith. The operation of the link responsive to the energization of the start circuit for selecting an idle toll cordless position may be the same as fully described in the aforementioned patent application to King et al. and the operation of the operator's equipment and associated position sender may also be the same as described in detail in this patent application. When the designation of the desired connection is given to the toll cordless operator by the distant toll operator, a key-set is actuated for setting the proper registers in the sender 101. As soon as the register is set, a connector 117 is energized by the sender for selecting an idle marker associated therewith. This marker is then associated with the sender and the code registrations transferred to the register of the marker which operates in the manner fully disclosed in the aforementioned patent application to King et al.

The character of outgoing trunk for completing the telephone connection is registered by the cordless operator, this information being transferred to the marker. When the incoming trunk is connected directly to an incoming sender, the character of outgoing trunk is automatically registered. The trunk to be used may be either a via intertoll trunk or a terminal intertoll trunk. A terminal intertoll outgoing trunk would be used for a call originating in the area of this toll center which entered this office over an incoming trunk from a tandem office to be routed to and terminated in the next distant toll office. However, if this call is to be routed through the next distant toll office to another toll office a via intertoll outgoing trunk must be selected. As previously stated a combined intertoll trunk may be

used for either character of call if the desired intertoll trunk is not available. For the first example of operation let it be assumed that the registration is for a via trunk extending to a distant toll office. Responsive to the selection of an idle marker, ground from a relay in the connector operates relay 118 which establishes a circuit for what is known as an off-normal relay, indicated as 409 and 507, and also establishes a circuit for relay 105 if the marker register has correctly responded to the key-set operated by the cordless operator and the registrations in the marker have been completed and indicate that no trouble exists in the marker seized. The circuit for relay 105 is thus completed from a register relay, through the contact of relay 118, winding of relay 105 to battery. The setting of the register relay also establishes the character of outgoing trunk to be selected by establishing a circuit for one of relays 504 or 505. The circuit established for relay 505 provides a circuit for establishing a connection to a via trunk. The operation of relay 504 establishes a circuit for completing a connection to a terminal trunk. Since in this example a via trunk is used, relay 505 is operated from battery through its winding and through a series of contacts in the registers which are closed when a via trunk is to be selected to a ground on a register relay which terminates this series circuit through said contacts.

A circuit for the selection of a particular route relay is also established through the operation of particular register relays which are set in combinations for the selection of any route relay in the office. The operation of relay 105 establishes ground circuits through contacts 1 to 6 for controlling the marker circuits. Contacts 1 to 5 establish ground circuits to the register relays which extend through the contacts of these relays to a plurality of tens relays, such as 104. These relays are operated for establishing circuits to a plurality of fifties relays, such as 106 and 107. The operation of the register relays, however, completes a circuit for only one particular fifties relay. It may be assumed in this case that a circuit is established for relay 106 from battery through its winding and through a series of register relays to ground on contact 1 of relay 105. A circuit is thus established for a particular route relay from ground through contact 2 of relay 105, contact 1 of tens relay 104, contact of the fifties relay 106, winding of route relay 108 to battery. Route relay 108 is operated and may be used for the selection of either a via or a terminal trunk. The character of trunk in a subgroup to be first tested is governed by the operation of relay 505, previously described. The operation of relay 105, previously described, also establishes a circuit for a ground supply relay 310. This circuit is obvious and need not be traced. The following circuits are established through the contacts of relay 310 at the time that the circuits are established for operating the tens, fifties and the route relays: ground through contact 1 of relay 310 extends through the inner contact of relay 505, the outer contact of relay 504 which is normal, winding of via relay 508 to battery, which operates the via relay 508 for governing switching circuits to be described later. Ground through contacts 2 and 3 of relay 310 is connected through contacts of a ground supply circuit shown in the upper portion of Fig. 3 for operating apparatus through the contacts of the route relay. Ground through contact 4

of relay 310 establishes a circuit through the contacts of relay 506 used on a second trial of the marker. This relay 506 is not of particular interest in connection with this invention with the exception of completing circuits through its normal contacts. The use of the ground supplied through contact 5 of relay 310 will be described in connection with the test of trunks.

Circuits established through the contacts of the route relay, when it is operated, arrange the testing apparatus of the marker for testing the trunks of a via group, which in this case is a small group of trunks within a larger group under the control of this route relay. As previously stated the test may be switched to a second subgroup within the larger group if no trunks are found idle in the first group tested. The control of this switching arrangement is established by the operation of a control relay in a circuit from ground on contact 1 of relay 301, contact 1 of the route relay 108, winding of relay 308 to battery. Relay 308 is one of a number of relays known as pattern or switching circuit control relays. Three pattern relays are shown, 307, 308 and 309. There may be as many of these relays as there are switching control arrangements required in an office. Each relay is cross-connected to as many route relays as give the same type of service in the office and may be wired according to a cross-connecting arrangement as shown on frame 314. The circuits through the contacts of relay 308 will be described in connection with the trunk switching circuit arrangement. Relay 311 is operated through contact 2 of route relay 108 over a circuit extending to ground on contact 3 of relay 300. The operation of relay 311 selects a connector between the marker and relays which control the group of trunks containing the subgroup to be tested. Let it be assumed in tracing the circuit for actuating this connector that the marker was seized by an even sender. Two relays are shown, 312 and 313, one of which is operated when an odd sender seizes the marker and the other is operated when an even sender seizes the marker. An even sender establishes the circuit shown from battery through the winding of relay 313 to ground in the sender 101. The circuit for energizing a connector may thus be traced from ground, through relay 407, contact 1 of relay 311, contact 2 of relay 312, contact 1 of relay 313 to battery. The operation of the connector relay 407 establishes an obvious circuit for a multicontact relay 406 which associates a number of trunk block relays with the marker. Each trunk block relay is associated with a group of intertoll trunks, usually comprising forty trunks. It is clear that only one such group is associated with the marker for test, since the testing apparatus is limited to a test of a group which is usually forty trunks. In order to select a particular group that is associated with the contacts of the multicontact relay 406, a relay in the marker is operated through the contacts of this particular route relay. For this purpose, relay 411 is energized from battery through its winding, contact 3 of the route relay 108 to ground on contact 4 of relay 300. A marker contains as many relays such as 411 or 412 as there are trunk groups connected with the multicontact relay such as 406. This should not be confused with subgroups, since there may be a plurality of subgroups in each group and each subgroup may have trunks of a different character from the other subgroups within the group.

Thus if there are ten groups associated with the multicontact relay 406 each having a plurality of subgroups therein, there are only ten relays such as 411 or 412, each one selecting one of the groups. In this case trunk block relay 404 is operated from ground through its winding, contact 4 of relay 406, contact 1 of relay 411, contact 1 of relay 417 to battery through contact 2 of relay 409. The operation of the trunk block relay 404 establishes a circuit through its contact 4 and contact 7 of relay 406 for operating relay 416. The circuit for the trunk block relay is now held through contact 2 of relay 416 and a test circuit is established through contact 1 of relay 416. This test circuit establishes an operating circuit for relay 413 which may be traced from battery through the winding of relay 413, thence over a series circuit through the normal contacts of relays 226, 225, 224, 223, 222, 221, 220 and 219, contact 1 of relay 416 to ground on contact 5 of relay 310. The operation of relays 413 and 416 remove the shunt around the winding of relay 414 which now operates from ground on the contact of relay 507 through resistance 520, winding of relay 414 to battery on contact 1 of relay 409.

At the same time as the foregoing operations take place, the limit of the subgroup of trunks is marked through the contacts 4 and 5 of the route relay over a circuit including apparatus operated by the registers when the marker was seized. This circuit includes the via relay 508 and may be traced from ground through contact 1 of relay 310, contact 2 of relay 508 which is operated as previously stated, contact 1 of relay 509 which is normal, contact 2 of relay 511 which is normal, contacts 7 and 8 of relay 300 which is normal, contacts 4 and 5 of the route relay 108 to the windings of relays 203 and 204. The circuit through the winding of relay 203 extends through the winding of relay 200 to battery and the circuit through the winding of relay 204 extends through the winding of relay 201 to battery. Relays 200 and 201 only enter into the operation of this circuit in the capacity of operating a timing circuit. If these relays remain operated longer than a given time period the apparatus of the time alarm 202 indicates a trouble condition. Relays 203 and 204 are operated in the circuit traced. Relay 203 indicates the first trunk of the subgroup to be tested and relay 204 indicates the last trunk of the subgroup to be tested. It may be assumed that this subgroup constitutes twelve via trunks and thus a test is made of these trunks in an effort to find an idle via trunk over which the telephone connection may be extended. The testing apparatus comprises the relays in three horizontal rows of Fig. 2. Relays in the first horizontal row 203 to 210, as previously described, are used to mark the start and end of the trunks of a subgroup to be tested. Relays for four subgroups are shown. Since there are usually forty trunks in a group there are also forty relays in each horizontal row for testing these trunks. The intermediate relays between 203 and 204 are not shown. Likewise, the intermediate relays between 205 and 206, 207 and 208, 209 and 210 are not shown. Relays 211 and 219 are used for testing the first trunk of the subgroup containing the via intertoll trunks. Relays 212 and 220 are used for testing the last trunk of this subgroup. The intermediate relays are not shown. This is the case in the remaining relays of the lower two horizontal rows which have relays only associ-

ated with the first and last trunks of the subgroups given as an example. In the test of trunks a chain circuit is established through the contacts of relays 211 to 212 extending through contacts of all intermediate relays. These relays are directly connected with apparatus associated with the via intertoll trunks. The circuit indicating this may be traced from battery through the winding of relay 211, contact 1 of relay 219, contact 3 of relay 227 which is normal, contact 2 of relay 406, contact 2 of trunk block relay 404 to an outgoing intertoll trunk circuit indicated diagrammatically at 402. When this circuit is idle, battery through the outgoing trunk relay 420 is associated with the circuit traced. When the outgoing trunk is busy, ground is associated with the circuit traced. It may be seen from this that relays such as 211 to 212 associated with idle trunks will remain normal and relays such as 211 to 212 associated with busy trunks will be operated. The test circuit for selecting an idle trunk extending through a chain circuit of relays 211 to 212 thus finds the first normal relay which indicates the first idle trunk and extends a circuit through the contacts of this relay for seizing this idle trunk.

Since, as previously described, relays 413 and 416 operated in a normal manner, indicating that all circuit paths are clear and operative, the circuit for relay 414 is established, completing the trunk testing circuit which may be traced as follows: Ground on contact 5 of relay 310 is extended through contact 1 of relay 416, contact of relay 414, contact 1 of the end relay 204, contact 1 of start relay 203, contact 1 of relay 413, contact 1 of relay 415, contact 2 of relay 293 to contact 1 of relay 211. If this relay is operated indicating a busy trunk the circuit extends from the armature to the inner contact and continues over a chain circuit through the contacts of all relays which are operated. If relay 211 is normal, or another relay in the chain is normal, indicating that the trunk associated therewith is idle, the test circuit continues from the armature through the outer contact of the normal relay and through the winding of a relay such as 219 to contact 3 of relay 514 normal, contact 4 of relay 513 normal, to battery, which operates a relay in the lower horizontal row which may be relay 219 if relay 211 was found normal or a corresponding relay associated with another trunk. The same circuit would be completed for any relay 219 to 220 which was associated with the normal relay in the horizontal row 211 to 212, indicating that the circuit associated with the normal relay is idle. Assuming that the first trunk is idle and that relay 219 operated, a circuit is established from a potentiometer including resistances 230 connected to battery and 231 connected to ground, which circuit extends through contact 1 of relay 219, contact 3 of relay 227, contact 2 of relay 406, contact 2 of relay 404 to the idle outgoing intertoll trunk circuit, operating a trunk relay such as 420 and thus associating ground with the circuit just traced so that another marker having a circuit the same as the one herein described will find the trunk busy when it makes the same character of test. The potentiometer herein diagrammatically shown comprises a group of apparatus which, when associated with an idle trunk, makes other tests of the trunk subsequent to its seizure. This is fully described in the aforementioned patent application of King-McKim-Myers filed Sept. 15, 1939.

A different condition arises when all of the trunks in the via subgroup comprising the first subgroup of trunks of the group are found busy. In this case apparatus is operated which transfers the test to a subgroup containing a plurality of combined intertoll trunks which if found idle, may be used as a via intertoll trunk. When there are more than one subgroup within a group, a circuit is established for a switching relay when the test is initiated. In this example the test was started with the subgroup of via trunks and relay 510 is operated from ground on contact 1 of relay 310, contact 2 of the via relay 508, contact 1 of relay 509, contact 2 of relay 511, right winding of relay 510 to battery. A locking circuit is established for this relay through its left winding, contact 1 of relay 511 to contact 1 of relay 415 to ground on contact 5 of relay 310. Relay 510 remains operated during the test of the via trunks and if an idle trunk is found it is released along with the release of other marker apparatus. When the twelve via trunks in the via subgroup are found busy, the twelve relays 211 to 212 are operated which establishes a circuit for relay 513 which is operated to effect a transfer. This relay is operated from battery through its winding, contact 3 of end of subgroup relay 204, contact 1 of last trunk test relay 212 and contact 1 of other intermediate relays, contact 1 of the first trunk test relay of the subgroup 211, contact 2 of start of subgroup relay 203, contact 1 of normal relay 415, contact 1 of operated relay 416, to ground on contact 5 of relay 310. The operation of relay 513 opens the battery circuit through its contact 4 for the lower horizontal row of relays 219 to 226 in Fig. 2 and establishes a circuit for operating relay 511. This may be traced from battery through the winding of relay 511, contact 3 of relay 510, contact 5 of relay 513 to ground on contact 1 of relay 310. The operation of relay 511 establishes a locking circuit for itself, opens the operating circuit for via trunk subgroup start and end relays 203 and 204 and opens the locking circuit for relay 510 which was established through its contact 1. The locking circuit for relay 511 is established through its contact 1, contact 1 of relay 416 to ground on contact 5 of relay 310. The release of relays 203 and 204 opens the circuit for relay 513 which releases. The release of relay 510 and the operation of relay 511 now establishes a circuit for testing the combined intertoll trunks by first energizing relay 500 over a circuit from battery through its left winding, contact 3 of relay 501, contact 2 of the trunk pattern relay or switching circuit control relay 308, contact 1 of relay 510, contact 2 of relay 511, contact 1 of relay 509, contact 2 of relay 508 to ground through contact 1 of relay 310. The operation of relay 500 marks the starting and ending trunks to be tested in the combined subgroup of intertoll trunks. This circuit is traced from ground through contact 1 of relay 310, contact 2 of relay 508, contact 1 of relay 509, contact 1 of relay 511, contact 1 of relay 510, contact 2 of the trunk pattern relay 308, contact 3 of relay 501, contacts 9 and 10 of relay 300, contacts 6 and 7 of the route relay 108 to the windings of relays 205 and 206 to battery through relays 200 and 201. Relay 205 marks the start of the combined subgroup of trunks and relay 206 marks the end of the subgroup of trunks. As previously explained, the intermediate relays are not shown. The combined group of trunks may be assumed to ex-

tend from trunk 12 to trunk 23 comprising a subgroup of twelve trunks. The trunks of this group are tested in the same manner as described for testing the subgroup of via trunks 0 to 11. If an idle trunk is found in this subgroup it is selected in the manner previously described. However, if no idle trunk is found because the twelve relays 213 to 214 are operated, a circuit is established for relay 513 which is again operated over a series circuit through the contacts of the test relays of this combined subgroup of intertoll trunks. This circuit is traced from battery through the winding of relay 513, contact 3 of relay 206, contact 1 of relay 214, contact 1 of the intermediate relays, contact 1 of relay 213, contact 2 of relay 205, contact 1 of normal relay 415, contact 1 of operated relay 416, to ground on contact 5 of relay 310. The second operation of relay 513 releases the previously operated relays of Fig. 2 and now establishes a circuit for testing overflow trunks comprising a subgroup of trunks 34 to 39. This is accomplished in the following manner. A circuit is first established for relay 501 from battery through its winding, contact 2 of relay 500, contact 5 of relay 513 to ground through contact 1 of relay 310. The operation of relay 501 opens the locking circuit for relay 500, causing its release, opens the circuit for relays 205 and 206 which release and establishes a locking circuit for itself through its contact 1. The release of relays 205 and 206 cause the release of relay 513. A circuit is thus established for the operation of overflow relay 512 from battery through its winding, contact 4 of relay 500, contact 3 of relay 501, contact 2 of relay 308, contact 1 of relay 510, contact 2 of relay 511, contact 1 of relay 509, contact 2 of relay 508 to contact 1 of relay 310. The operation of relay 512 establishes a circuit from ground through its contact 2, contact 2 of normal relay 309, contact 1 of relay 508 through the winding of via overflow relay 227 to battery for operating the latter relay.

The operation of the via overflow relay 227 places a ground on alternate relays of the overflow group. In this circuit arrangement the overflow trunks are divided between the terminal and via trunks since calls over trunks of different characteristic are given a different treatment in the overflow circuit. When no idle trunk can be found for a call which should be routed over a via trunk, the connection is completed to an overflow trunk individual to calls for via trunks. A call for a terminal trunk is also routed to an overflow trunk individual to terminal trunks. When the via overflow relay 227 is operated, it grounds the terminal overflow trunks and thus only via overflow trunks are tested. The starting and ending points of the group are marked in the same manner as previously described for the via and combined groups. The circuit is associated with the overflow terminals of the route relay through the contacts of the via overflow relay 227 and may be traced from ground through contact 2 of relay 227, contacts 13 and 14 of relay 300, contacts 10 and 11 of the route relay 108 and thence through the windings of relays 209 and 210 to battery through the windings of relays 200 and 201. It may be assumed for this example that the overflow trunks comprise a subgroup from trunk 34 to trunk 39 which constitutes a group of six trunks. The ground circuits supplied through the contacts of relay 227 operate alter-

nate relays 217 to 228 which in this case would be the even relays 34, 36 and 38, permitting the odd relays 35, 37 and 39 to remain normal if the trunks associated therewith are idle. If any overflow trunks associated with the relays 35, 37 and 39 are busy, this busy condition would operate such of the three relays as are associated with the busy trunks. The circuit for operating even relay 34 may be traced from ground through contact 6 of relay 227, contact 1 of relay 225, winding of relay 217 to battery. The circuit for relays 36 and 38 extends from ground on contacts 7 and 8 of relay 227. The circuit arrangement is such that all of the even test relays in the horizontal row comprising relays 211 to 218 are operated in order that a standard arrangement may be provided for all markers and the overflow subgroup may be made as large as required. The operation of these even relays which are not in the overflow group does not effect any change in the subgroups which are not within the overflow group. The test of the odd-numbered overflow trunks 35, 37 and 39 is made in the same manner as previously described for the test of trunks in the other subgroups. This test circuit finds relay 217 operated and thus the first to be tested is the trunk associated with the next relay or trunk 35, which is not shown. When an idle overflow trunk is found, a relay such as 226 connected with the idle trunk is operated and the marker responds accordingly to connect with this idle overflow trunk by the operation of switches as described in detail in the aforementioned patent application to King et al.

The same route relay as used for the foregoing example of a telephone connection requiring an outgoing via intertoll trunk may also be used for a call requiring a terminal intertoll trunk which terminates in the next distant toll office. When a call requires a terminal intertoll trunk for completing a connection the registers of the sender and the marker are set accordingly and a circuit is completed for relay 504 instead of for relay 505. This circuit may be traced from battery through the winding of relay 504 through ground in the marker register which circuit is, of course, completed through a series of contacts on the register relays operated for establishing this circuit. The control relays 105, 118, 409 and 310 are operated in the same manner as previously described. The tens relay 104 and the fifties relay 106 are also operated in the manner previously described through contacts of the register relays to ground on the contacts of relay 105. This establishes a circuit for operating the route relay 108 through the contacts of the fifties relay 106, the tens relay 104 to ground on contact 2 of relay 105. Since the same route relay has been operated as before the same switching circuit control relay 308 is used in combination with the switching system. A change in the circuit arrangement, however, takes place since the terminal trunk relay 509 is operated instead of the via trunk relay 508. The circuit for relay 509 may be traced from battery through its winding, contact 2 of relay 504, contact 1 of relay 505, which is normal, to ground through contact 1 of relay 310. After the operation of route relay 108, a circuit is established for relay 311, the same as before for seizing a connector between the marker and the trunk assignment frame having the trunk block relays thereon. In this case the same trunk block is used and, therefore, a circuit is established for

relay 411, the same as previously described. It may be assumed that an odd sender was used for establishing the connection and consequently relay 313 is operated and relay 312 is normal. A circuit is thus established for the assignment connector relay 407 from ground through its winding, contact 1 of relay 311, contact 2 of relay 312, contact 1 of relay 313 to battery. This establishes an obvious circuit for relay 406 which, when operated, establishes circuits for associating the trunk block relay 404 and associated trunks with the marker. Relay 404 is operated from ground through its winding, contact 1 of relay 411, contact 1 of relay 417, contact 2 of relay 409 to battery. An obvious circuit is established for relay 416 from ground on contact 4 of relay 404, contact 7 of relay 406 to battery through the winding of relay 416. This closes a second circuit path for relay 404 through contact 2 of relay 416 and also establishes a circuit for relay 413 through the contacts of the trunk testing circuit, Fig. 2. The circuit for relay 413 may be traced from battery through its winding, contact 3 of relay 226 and contact 3 of all other relays in this horizontal row, thence through contact 1 of relay 416 to ground on contact 5 of relay 310.

Circuits have now been established for testing the subgroup of terminal trunks in the same group containing the via and combined trunks as previously described. A circuit is thus established for the starting and ending points of the terminal subgroup of the intertoll trunks. The circuit may be traced from ground on contact 1 of relay 310, contact 2 of relay 508, normal, contact 3 of relay 509, operated, contacts 11 and 12 of relay 300, contacts 8 and 9 of the route relay 108, windings of relays 207 and 208 to battery through the windings of relays 209 and 201, respectively. Relays 207 and 208 are operated in the circuit traced. The circuit traced from contact 3 of relay 509 also extends through the left winding of relay 502 to battery operating relay 502 in preparation for a switching operation if no idle trunks are found in the group of terminal trunks. The group of terminal trunks comprises ten trunks, 24 to 33. The intermediate relays governing the test of the intermediate trunks between 24 and 33 are not shown. When the relays in the horizontal row, including relays 215 to 216, are associated with the trunks through the trunk block relays or relays associated with busy trunks are operated from battery through the windings, such as relay 215, contact 1 of relay 223, contact 5 of relay 227 and thence through contacts on relay 406 and contacts on the trunk block relay 404 through the intertoll trunk circuits. An idle trunk has battery associated with this circuit through a trunk relay, such as shown in trunks 402 and 403, and a busy ground associated with this circuit for operating the relays in the horizontal row, including relays 215 to 216. A circuit is thus established through the contacts of all busy relays 215 to 216, extending to the armature and back contact of any relay which is normal indicating an idle intertoll trunk. The operation of one of the relays 223 to 224, associated with the first idle trunk, indicates to the marker that an idle trunk has been found. The circuit for operating relay 223, assuming that the first trunk was idle, may be traced from ground on contact 5 of relay 310, contact 1 of relay 416, contact of relay 414, contact 1 of relay 208, contact 1 of relay 207, contact 1 of relay 413, contact 1 of relay 415, contact 2 of re-

lay 297, contact 1 of relay 215, which is normal, winding of relay 222, contact 3 of relay 514 to battery through contact 4 of relay 513. In the circuit above traced if relay 215 is associated with a busy trunk this relay would have been previously operated and thus the circuit is extended from its armature through its inside contacts to the next relay associated with trunk 25. This series circuit continues to the relay 216 associated with the last terminal trunk. When all of the relays in this horizontal row, 215 and 216, are operated, thus indicating all of the terminal trunks in the subgroup are busy, a circuit is established for testing the combined trunks in the combined subgroup comprising test relay, 205 to 206, 213 to 214, and 221 to 222, which includes twelve combined intertoll trunks that may be used for completing a connection over a terminal trunk.

If an idle terminal trunk is found apparatus in the marker is operated to complete the connection over the cross-bar switches through this idle terminal trunk. Let it be assumed for this example, that all of the terminal trunks were busy and consequently a circuit is established for relay 513 which controls the switching from one subgroup to another. The circuit for relay 513 may be traced from battery through its winding, contact 1 of relay 297, contact 3 of relay 208, contact 1 of the last test relay 216, which is operated, thence over a series circuit through the contacts of the intermediate relays through contact 1 of relay 215, contact 2 of relay 207, contact 1 of normal relay 415, contact 1 of operated relay 416 to ground on contact 5 of relay 310. The operation of relay 513 opens the battery circuit through its right contact for the lower horizontal row of relay, Fig. 2, and establishes a circuit for operating relay 503 traced from battery through the winding of relay 503, contact 1 of relay 502, contact 5 of relay 513 to ground on contact 1 of relay 310. The operation of relay 503 opens the locking circuit for relay 502 which releases. The release of relay 502 and operation of relay 503 now establish the starting and ending points of the combined intertoll trunk subgroup for testing and opening the circuit which operated the relays 207 and 208 for marking the starting and ending points of the subgroup of terminal intertoll trunks. The circuit for marking the combined trunks may be traced from ground on contact 1 of relay 310, contact 2 of relay 508, contact 3 of relay 509, contact 2 of relay 503 which remains operated, contact 3 of relay 502, contact 1 of the front pattern relay 308, contact 3 of relay 501, which is normal, contacts 9 and 10 of relay 300, contacts 6 and 7 of route relay 108, windings of relays 205 and 206 to battery through the windings of relays 200 and 201, respectively. The circuit traced through contact 4 of relay 501 also extends through the left winding of relay 500 from battery and operates this relay which establishes a locking circuit for itself through its right winding, contact 3 and contact 2 of relay 501, contact 1 of relay 416, to ground on contact 5 of relay 310. The previous release of relays 207 and 208 disestablishes the circuit for relay 513 which released. Circuits are thus established for testing the intertoll trunks in the combined trunk subgroup as previously described. If an idle trunk is found in this subgroup of trunks, a combined intertoll trunk is used in this case as a terminal trunk and the telephone connection is completed by the marker to a distant office over this idle combined trunk. 75

If, however, no idle trunk is found, a circuit is established for routing the calling incoming trunk to an overflow trunk in the same manner as described for routing the calling incoming trunk to an overflow trunk where a via intertoll trunk had been registered for use as the outgoing trunk.

There are two relays associated with the overflow trunk circuits, relays 227 and 228. The use of relay 227 was previously described in routing the calling incoming trunk to a via overflow trunk. For the call now being described, relay 228 is operated in order to route the calling incoming trunk to a terminal overflow trunk and, therefore, a circuit is established for relay 228 from battery through its winding, contact 2 of terminal relay 509, contact 2 of relay 309 to ground on contact 2 of the overflow relay 512. It will be remembered that the overflow relay 512 is operated for routing calls to an overflow trunk. The circuit for this relay is established from battery through its winding, contact 4 of relay 500, contact 3 of relay 501, contact 1 of front pattern relay 308, contact 3 of relay 502, normal, contact 2 of relay 503, operated, contact 3 of terminal relay 509, contact 2 of relay 508, normal, to ground through contact 1 of relay 310. The operation of relay 228 connects ground to all of the via overflow relays, such for example, as all of the odd relays in the overflow group. Since the overflow group comprises six trunks, 34, 35, 36, 37, 38, and 39, the odd overflow relays associated with trunks 35, 37 and 39 would be operated in order that only the terminal overflow trunks will be tested. A circuit for relay 218 governing the test of trunk 39 may be traced from battery through its winding, contact of relay 226, contact 8 of relay 228 to ground. The alternate three trunks are tested in the manner previously described so that the incoming call may be routed to an idle one of these overflow trunks. The overflow trunk subgroup may comprise any number of trunks. A limited example of such a subgroup has been given.

The foregoing gives an example of the use of the control or pattern relay 308 and the switching relays of Fig. 5 as associated with a single route relay 108 for governing the tests of different characters of intertoll trunks which are under the control of this single circuit arrangement, the transfer being carried forward through the contacts of a single route relay. This example includes telephone connections requiring either a via intertoll trunk or a terminal intertoll trunk according to registrations in the sender and marker register and it is shown, in this example, that the one control relay 308 may be used for either type of registration for controlling the transferring from a subgroup of via trunks to a subgroup of combined trunks and if no idle trunks are found in these subgroups of trunks, a transfer being made to overflow trunks. A large plurality of such control or pattern relays may be used for various combinations of control. Relay 307 is another example of a different type of control of the switching relays shown in Fig. 5. When the switching circuit control or pattern relay 307 is connected with a route relay there are more than one route relays which may be operated to obtain access to trunks associated with a particular office.

Route relay 109 has three subgroups of trunks associated therewith, via intertoll trunks, terminal intertoll trunks and combined intertoll trunks, which may be used either as a via or terminal intertoll trunk. This route relay also

has a second route relay associated therewith which may have one or more subgroups of inter-toll trunks controlled through its contacts. An arrangement of this character is provided for trunks to an office originally assigned to a single group having three subgroups therein and later requirements are such that an additional group of trunks is placed under the control of another route relay. In an arrangement of this character a transfer is made to the second route relay after the trunks controlled by the first route relay are tested. Registrations in the sender and marker are made responsive to instructions over the calling incoming trunk in the same manner as previously described. For this example the same tens relay is operated through the contacts of the marker register and a different fifties relay 107 is operated. The combination in the marker register established a circuit for this fifties relay which controls the operation of route relay 109 having a circuit through its contact, contact 2 of tens relay 104, contacts of register relays to ground on contact 5 of relay 105. Relay 105 and other control relays of the marker may be assumed to have been operated as described for the previous call. Also for this call it will be assumed that a via trunk is required and, therefore, relay 505 is operated through the contacts of the marker register. The operation of relay 505 establishes a circuit for the via trunk relay 503 also as previously described. The operation of route relay 109 establishes a circuit for the control of switching circuit control relay 307 traced from battery through its winding, contact 1 of route relay 109 to ground on relay 300. The same assignment connector selecting relay is associated with this route relay as with route relay 108. This relay 311 operates from battery through its winding, contact 4 of relay 109 to ground on relay 300. A circuit is thus established for actuating connector relay 407 from ground through its winding, contact 1 of relay 311, contact 2 of relay 312, contact 1 of relay 313 to battery. The energization of relay 407 operates relay 406 as before. When the trunks of a different group are tested through the channels of this route relay, a different trunk block relay is operated. A circuit for trunk block relay 412 is established and may be traced from battery through its winding, contact 5 of route relay 109 to ground on contact 4 of relay 300. The energization of this marker trunk block control relay establishes a circuit for the trunk block relay 405 which associates the trunks of a particular group with the testing facilities of the marker. Relay 405 is operated from ground through contact 5 of relay 406, contact 1 of relay 412, contact 2 of relay 411, contact 1 of relay 417, contact 2 of relay 409 to battery. The operation of relay 405 establishes an obvious circuit for relay 416 as previously described. A circuit is also established for relay 413 through the contacts of relays 219 and 226 as previously described. Ground is now associated with a circuit for operating the start and end relays for marking the limits of the via subgroup of trunks which may be traced from contact 1 of relay 310, contact 2 of relay 508, contact 1 of relay 509, contact 2 of relay 511, contacts 7 and 8 of relay 300, contacts 6 and 7 of route relay 109, windings of relays 203 and 204, windings of relays 200 and 201 to battery. Relays 203 and 204 and 200 and 201 are operated in the circuit traced. The circuit traced also energizes relay 510 through its right winding for making a transfer if all trunks in the subgroup are busy. As previously stated

the relays 200 and 201 initiate the operating of a timing circuit which is of sufficient duration to permit all normal functions in the marker testing apparatus and indicates a trouble condition when this time extends over a longer period. The test of the via trunks is made in the manner previously described which it is believed does not need repetition. If an idle via intertoll trunk is found the marker controls the action of switches for interconnecting the calling incoming trunk with this idle via outgoing trunk. When all of the trunks in this subgroup are found busy a transfer is made by energizing relay 513. The circuit for operating relay 513 is the same as previously traced and need not be repeated. This establishes an operated circuit for relay 511 from battery through its winding, contact 3 of relay 510, contact 5 of relay 513 to ground on contact 1 of relay 310. The energization of relay 511 opens the locking circuit for relay 510 which was extended through its left winding and contact 1 of relay 511 and also opens the operated circuit for this relay. Relay 511 locks through its contact 1, contact 1 of relay 416, to ground on contact 5 of relay 310. The operation of relay 511 establishes circuits for testing the combined subgroup of trunks by connecting ground from contact 1 of relay 310 through contact 2 of relay 503, contact 1 of relay 509, contact 2 of relay 511, contact 1 of relay 510, contact 2 of the trunk pattern control relay 307, contact 4 of relay 501, normal, contacts 9 and 10 of relay 300, contacts 8 and 9 of the route relay 109, windings of start and end relays 205 and 206 to battery through the windings of relays 200 and 201. This marks the first and last trunk in the combined subgroup of trunks. This circuit also is extended through the left winding of relay 509 which operates this relay. The trunks of the combined group are now tested in a manner previously described and if no idle trunk is found relay 513 is again operated. It should be noted that route relay 109 does not have a subgroup of overflow trunks associated with its contacts because it is arranged for transferring the test to another group of trunks under the control of route relay 110. The switching circuit control relay 307 is, therefore, arranged to cause the abandonment of the group control by route relay 109 and assume control of the trunks associated through the contacts of relay 110. The operation of relay 513 establishes an energizing circuit for relay 501 from battery through its winding, contact 2 of relay 500, contact 5 of relay 513, to ground on contact 1 of relay 310. This opens the locking circuit for relay 500 which releases. A circuit is thus established for a series of operations to effect a transfer to route relay 110 including the operation of all trunks busy relay 514. A circuit is established for this relay from battery through its winding, contact 1 of relay 500, contact 4 of relay 501, contact 1 of relay 510, contact 2 of relay 511, contact 1 of relay 509, contact 2 of relay 508 to ground on contact 1 of relay 210. The operation of relay 514 transfers the control circuits from route relay 109 to route relay 109 by ultimately effecting the operation of route relay 300 which is generally known as the ground supply relay. Relay 302 is first operated over a circuit from battery through its winding, contact 15 of relay 500, contact 3 of route relay 109 to ground on contact 4 of trunk busy relay 514. Relay 302 establishes a locking circuit for itself from battery to its winding, and contact 4 to ground on contact 4 of relay 514. The operation

of relay 302 establishes a circuit for relay 303 from battery to its winding, contact 6 of relay 302 from ground on contact 2 of relay 310. A locking circuit is established for relay 303 through its winding and contact 3, contact 5 of relay 304, contact 5 of relay 302, to ground on contact 2 of relay 310. With relays 302 and 303 operated a circuit is established for relay 300 from battery through its winding, contact 2 of relay 302, contact 2 of relay 303 to ground on contact 2 of relay 310. A locking circuit is established for relay 300 through its winding and contact 5, contact 4 of relay 303 to ground through contact 2 of relay 310. The operation of relay 300 opens the operating and locking circuits for the following relays: Control relay 307, assignment connector relay 311, trunk block control relay 412, assignment connector relays 407 and 406, trunk block relay 405, which opens the circuit for relay 416, leads, to the test relays Fig. 2, are opened and relays 413 and 513 are released. The release of relay 307 opens the operating circuit for relay 514 and the release of relay 416 opens the locking circuit for relay 514 thus causing its release which removes ground from the locking circuit for relay 302 which now releases. The release of relay 302 establishes a circuit for the new route relay 110 which may be traced from battery through its winding, contact 2 of route relay 109 which remains operated, contact 6 of relay 300, contact 3 of relay 302, contact 2 of relay 306 to ground on contact 3 of relay 310. Relay 306 is merely shown for completing circuits and does not enter into the operation of this circuit so far as this invention is concerned. The test has now been placed under the control of route relay 110 which when operated energizes the apparatus of the marker in a manner herein described. An operating circuit for the same switching circuit control relay 307 may be connected through the contact of relay 110 in order that the test may proceed in the same manner as it did through the contacts of the route relay 109. The test control leads through contacts 7 to 15 of relay 301 may be assumed to be in the same order as the control leads associated with route relay 109. The procedure in the switching circuit may be assumed to be the same and the procedure when an idle trunk is found is the same for associating the calling incoming trunk with the idle outgoing trunk.

A diagrammatic showing is made for a connector frame used by the marker for associating its control leads with a cross-bar switch connected with an idle trunk which has been selected. This connector circuit and apparatus may be assumed to be the same as fully described in the patent application of King-McKim-Myers, Serial No. 295,010, filed Sept. 15, 1939. When the circuit paths have been properly established through the cross-bar switches a circuit is completed in this connector for relay 425 which establishes a circuit for the switching select magnet 426 over a circuit which may be traced from ground through the transformer control winding 427, select magnet winding 426, contact 1 of trunk block relay 404, contact 1 of connector relay 406, contact 2 of relay 209, which assumes that the zero trunk was found idle, thence over a circuit to contact 1 of relay 506 to battery on the contact of relay 425. The hold magnets of the switches are subsequently energized for completing the path from the calling incoming trunk to the selected outgoing trunk.

The switching circuit control relay 309 is oper-

ated through the contacts of a route relay in the manner described for relays 307 and 308. Relay 309 is used in conjunction with a route relay having one character of trunks in the group of trunks associated therewith, which may be either terminal or via intertoll trunks, and a subgroup of overflow trunks. The overflow trunks would therefore all be of a given character. Relay 309 directs the test of these trunks for finding an overflow trunk on any of the terminals by controlling the switching circuit transfer from the trunks of the group to the overflow trunks without operating relays 226 or 288.

What is claimed is:

1. In a telephone system, a telephone office, incoming lines, outgoing lines in groups having a plurality of subgroups, a marker, route relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a group by the operation of a single route relay, and means responsive to the registrations in said register for operating said single route relay and for designating a particular one of said subgroups of lines to be tested for the selection of an idle outgoing line.

2. In a telephone system, a telephone office, incoming lines, outgoing lines in groups having a plurality of subgroups, the lines of each subgroup being of different character for different characters of telephone connections, a marker, route relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a group by the operation of a single route relay, and means responsive to registrations in said register for operating said single route relay and for designating one of said subgroups of lines having lines of a particular character to be tested for the selection of an idle outgoing line.

3. In a telephone system, a telephone office, incoming lines, outgoing lines in groups having a plurality of subgroups, a marker, route relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a group by the operation of a single route relay, means responsive to the registrations in said register for operating said single route relay and for designating a particular one of said subgroups of lines to be tested for the selection of an idle outgoing line, a switching circuit, and means including said single route relay when operatively connected to said testing means for successively testing the trunks in a plurality of said subgroups of lines within the capacity of said testing means under the control of said switching circuit.

4. In a telephone system, a telephone office, incoming lines, outgoing lines in groups having a plurality of subgroups, a marker, route relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a

group by the operation of a single route relay, means responsive to the registrations in said register for operating said single route relay and for designating a particular one of said subgroups of lines to be tested for the selection of an idle outgoing line, a switching circuit connected through a plurality of contacts on said single route relay to said testing means, means including said single route relay when operatively connected to said testing means for testing other of said subgroups of lines after the designated subgroup has been tested, and means in said switching circuit for controlling the successive order of testing said subgroup of lines by controlling the operation of said testing means through different route relay contacts.

5. In a telephone system, a telephone office, incoming lines, outgoing lines in groups having a plurality of subgroups, a marker, route relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a group by the operation of a single route relay, means responsive to the registrations in said register for operating said single route relay and for designating a particular one of said subgroups of lines to be tested for the selection of an idle outgoing line, a switching circuit connected through a plurality of different contacts of said route relays to subgroup marking devices in said testing means, means including said single route relay when operatively connected to said testing means for testing a plurality of said subgroups of lines, and means in said switching circuit for successively operating certain of said marking devices by establishing the operating circuits for different marking devices through different route relay contacts.

6. In a telephone system, a telephone office, incoming lines, outgoing lines in groups having a plurality of subgroups, a marker, route relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a group by the operation of a single route relay, means responsive to the registrations in said register for operating said single route relay and for designating a particular one of said subgroups of lines to be tested for the selection of an idle outgoing line, a switching circuit, a device for controlling the progressive operations of said switching circuit according to the registrations recorded, and means in said switching circuit for controlling the testing of subgroups of lines in the order directed by said switching circuit control device.

7. In a telephone system, a telephone office, incoming lines, outgoing lines in groups having a plurality of subgroups, a marker, route relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a group by the operation of a single route relay, means responsive to the registrations in said register for operating said single route relay and for designating a particular one of said subgroups of lines to be tested for the selection of an idle

outgoing line, a switching circuit, a device for variably controlling the progressive operations of said switching circuit according to the registrations recorded, and means in said switching circuit for controlling the testing of subgroups of lines in the order directed by said switching circuit control device.

8. In a telephone system, a telephone office, incoming lines, outgoing lines in groups having a plurality of subgroups, a marker, route relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a group by the operation of a single route relay, means responsive to the registrations in said register for operating said single route relay and for designating a particular one of said subgroups of lines to be tested for the selection of an idle outgoing line, a switching circuit, a device for controlling the progressive operations of said switching circuit, a circuit for said control device established by the operation of said route relay, a second circuit for said control device established by the operation of said register relays, and means in said switching circuit for controlling the testing of subgroups of lines under the direction of said switching circuit control device.

9. In a telephone system, a telephone office, incoming lines, outgoing lines in groups having a plurality of subgroups, the lines of each subgroup being of different character for different characters of telephone connections, a marker, route relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a group by the operation of a single route relay, means responsive to registrations in said register for operating said single route relay and for designating one of said subgroups of lines having lines of a particular character to be tested for the selection of an idle outgoing line, a switching circuit connected through a plurality of different contacts on said route relay to said testing means, means including said single route relay when operatively connected to said testing means for testing other of said subgroups having a different character of lines after the designated character of lines have been tested, and means in said switching circuit for controlling the successive order of testing said subgroups of lines by controlling the operation of said testing means through said different route relay contacts.

10. In a telephone system, incoming toll lines, outgoing toll lines of different character grouped according to their character, a marker, a register in said marker, route relays in said marker for routing line connections, means to obtain access to groups of lines of different character by registering a routing for a line of one character in said marker, means responsive to said registration for operating a route relay governing the routing of the lines of different character in said group, a switching circuit for switching from lines of one character in one group to lines of another character in another group, a switch controlling device for governing the order of switching from lines of one character to lines of a different character, and means to operate said

switching circuit under the direction of said switch controlling device responsive to busy marks on the lines of a group of any given character.

11. In a telephone system, incoming lines, outgoing lines in groups which are divided into subgroups, a marker for controlling the interconnection of said lines, a register in said marker, route relays in said marker for routing calling incoming lines to idle outgoing lines of particular subgroups as registered over a calling incoming line, a set of relays in said marker common to the route relays of the marker arranged to designate the busy and idle lines of a group, certain of said groups being divided into subgroups with lines of different character in each subgroup, means associated with certain of individual route relays including different contacts thereof for marking the start and end points of test for each different subgroup in a group, a switching system for switching the testing of lines from one subgroup to another subgroup, a switching circuit controlling device for directing the order of switching from the subgroup registered to other subgroups by successively connecting said switching circuit to said different contacts of a single route relay, and means operatively responsive to busy marks on the lines of a subgroup for operating said switching system as directed by the switching circuit control device.

12. In a telephone system, a toll telephone office, incoming toll lines, outgoing toll lines in a group having a plurality of subgroups comprising via intertoll lines, terminal intertoll lines and combined intertoll lines, a marker, route

relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a group by the operation of a single route relay, and means responsive to registrations in said register for operating said single route relay and for designating a via or terminal subgroup of lines to be tested for the selection of an idle outgoing line.

13. In a telephone system, a toll telephone office, incoming toll lines, outgoing toll lines in groups having a plurality of subgroups comprising via intertoll lines, terminal intertoll lines and combined intertoll lines, a marker, route relays in said marker, a register in said marker set according to designations transmitted over a calling line, testing means in said marker common to the groups of lines in said office and the route relays of said marker arranged for simultaneous connection with said plurality of subgroups in a group by the operation of a single route relay, means responsive to registrations in said register for operating said single route relay and for designating a via or terminal subgroup of lines to be tested for the selection of an idle outgoing line, a switching circuit, and means including said single route relay when operatively connected to said testing means for testing the combined subgroup of lines under the control of said switching circuit responsive to a signal transmitted when the lines of the first subgroup tested are all found busy.

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