

Dec. 3, 1929.

E. E. HINRICHSEN

1,738,245

TELEPHONE SYSTEM

Filed Nov. 1, 1928

5 Sheets-Sheet 1

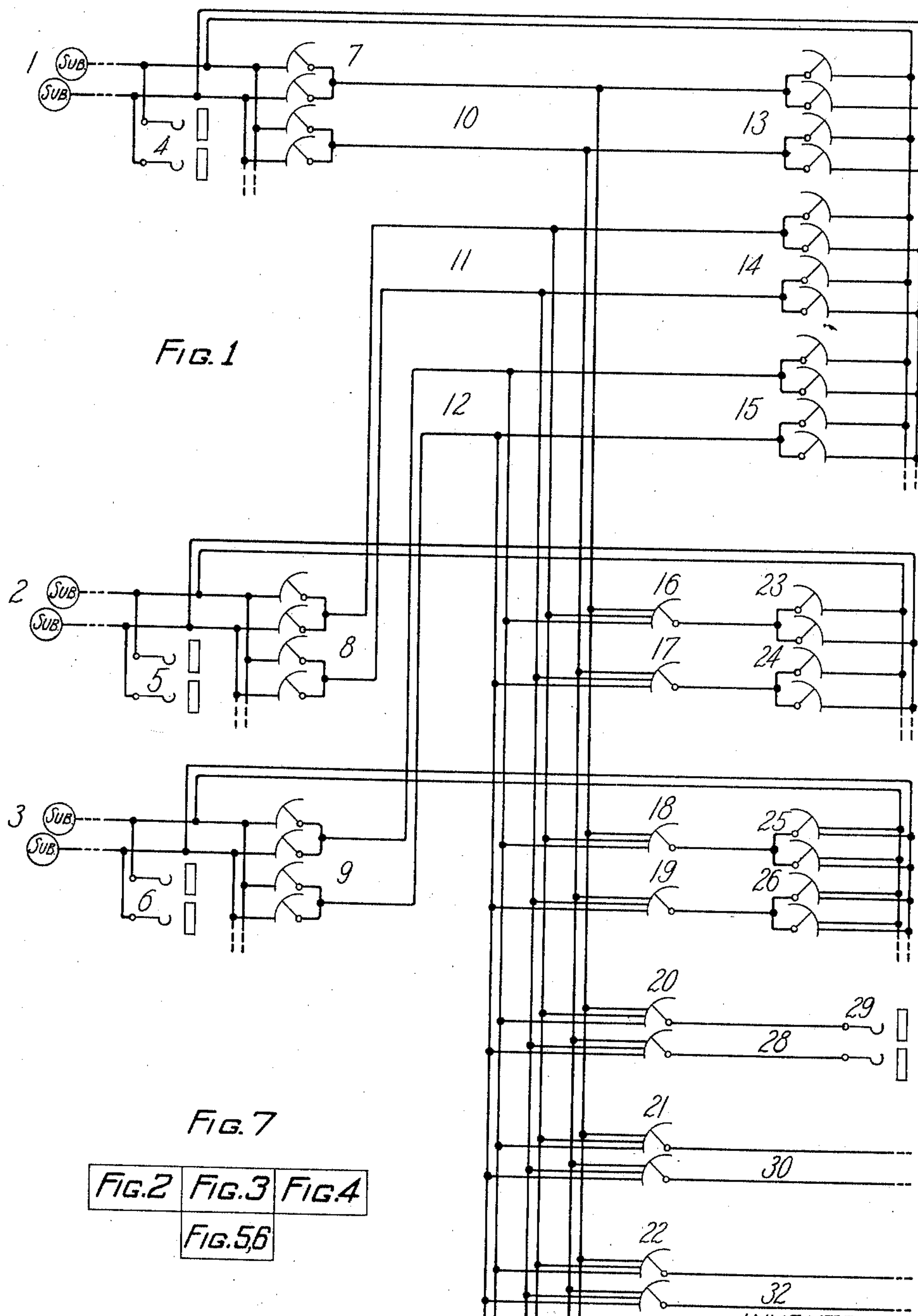


FIG. 2 FIG. 3 FIG. 4
FIG. 5, 6

INVENTOR
E. E. HINRICHSEN
BY
M. P. McFerry
ATTORNEY

Dec. 3, 1929.

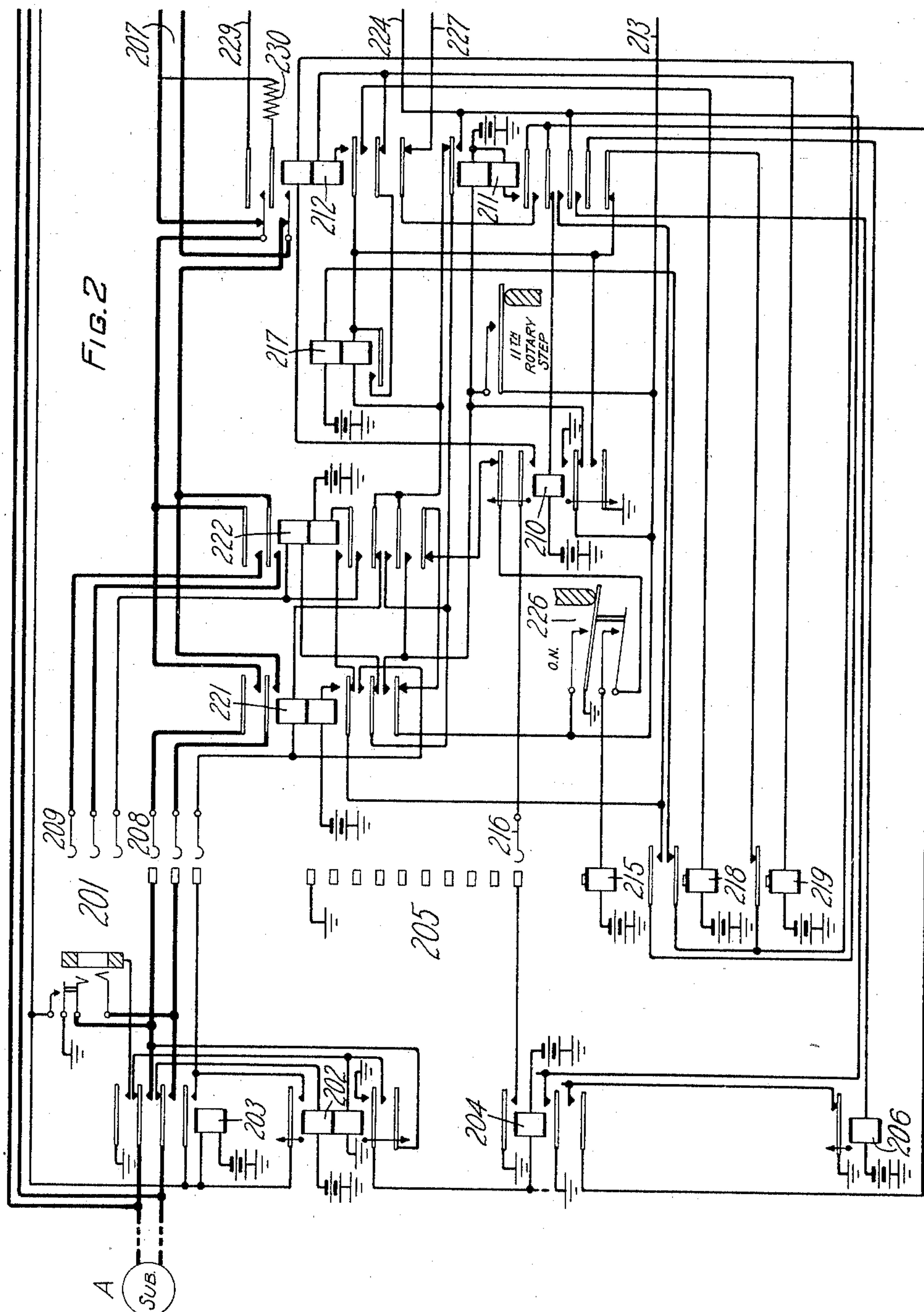
E. E. HINRICHSEN

1,738,245

TELEPHONE SYSTEM

Filed Nov. 1, 1928

5 Sheets-Sheet 2



INVENTOR
E. E. HINRICHSEN
BY *M. J. McFerry*
ATTORNEY

Dec. 3, 1929.

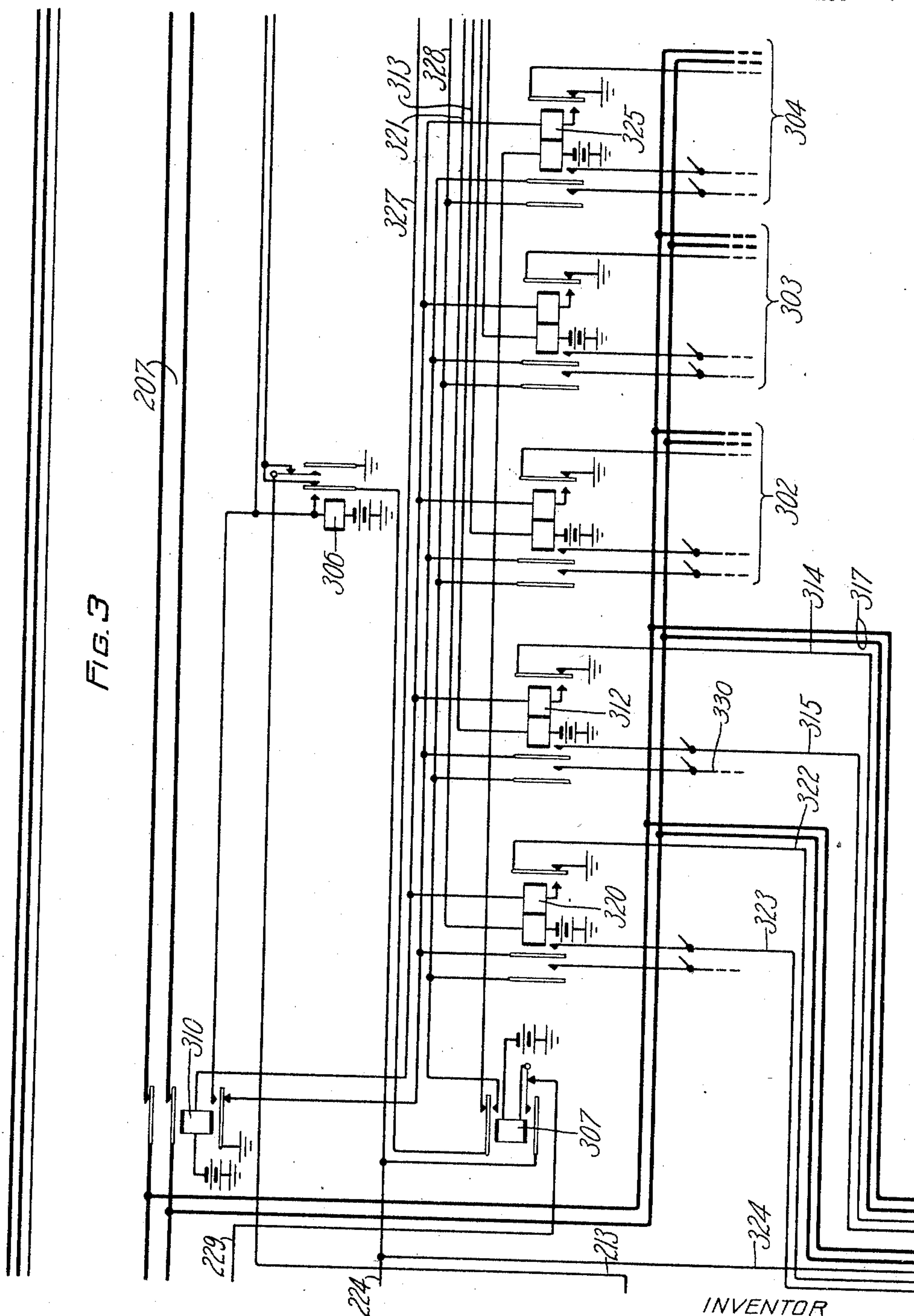
E. E. HINRICHSEN

1,738,245

TELEPHONE SYSTEM

Filed Nov. 1, 1928

5 Sheets-Sheet 3



INVENTOR
E. E. HINRICHSEN
BY *MORRIS KENNEY*

ATTORNEY

Dec. 3, 1929.

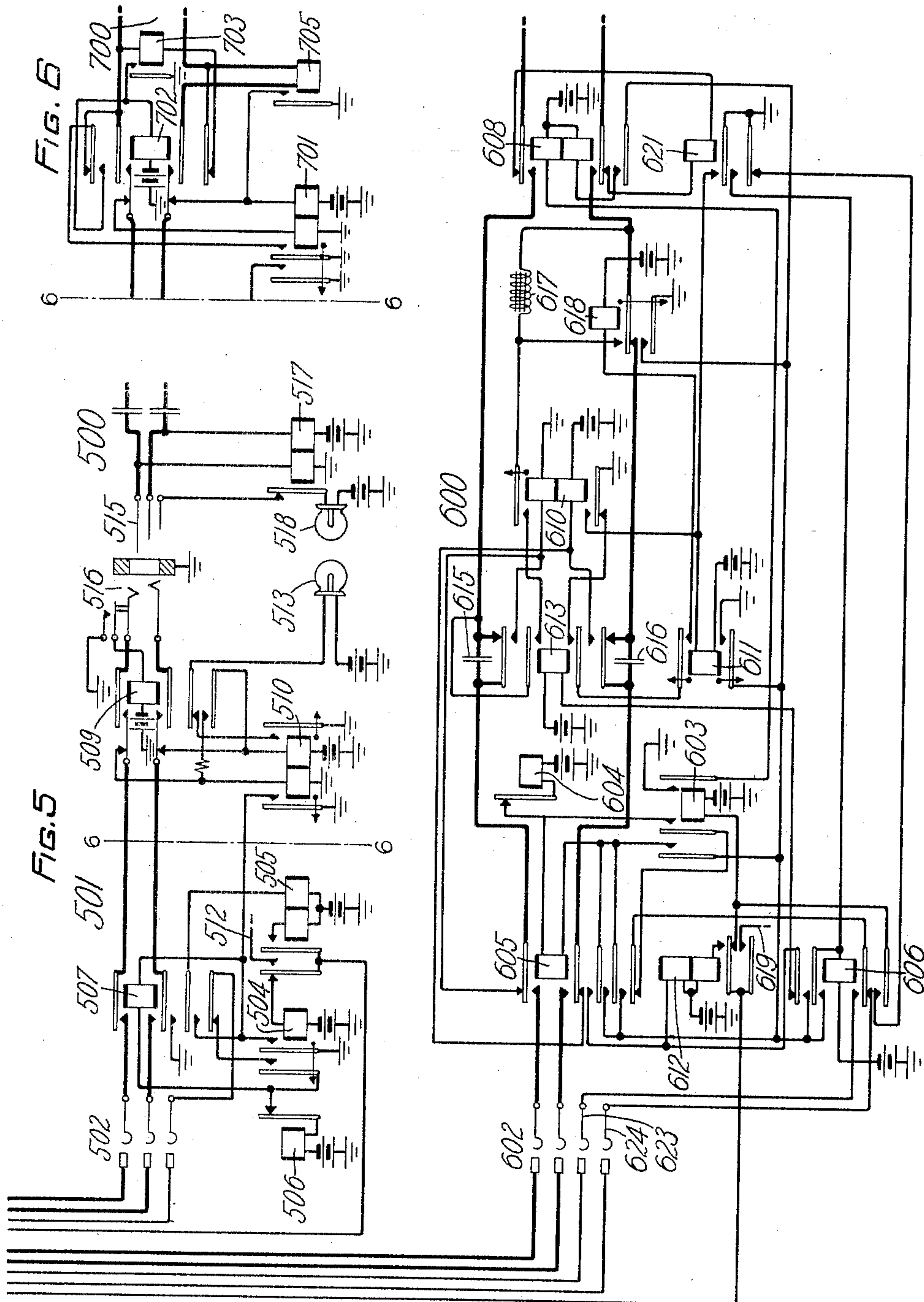
E. E. HINRICHSEN

1,738,245

TELEPHONE SYSTEM

Filed Nov. 1, 1928

5 Sheets-Sheet 4



INVENTOR
E. E. HINRICHSEN
BY *W. M. McFerry*

ATTORNEY

Dec. 3, 1929.

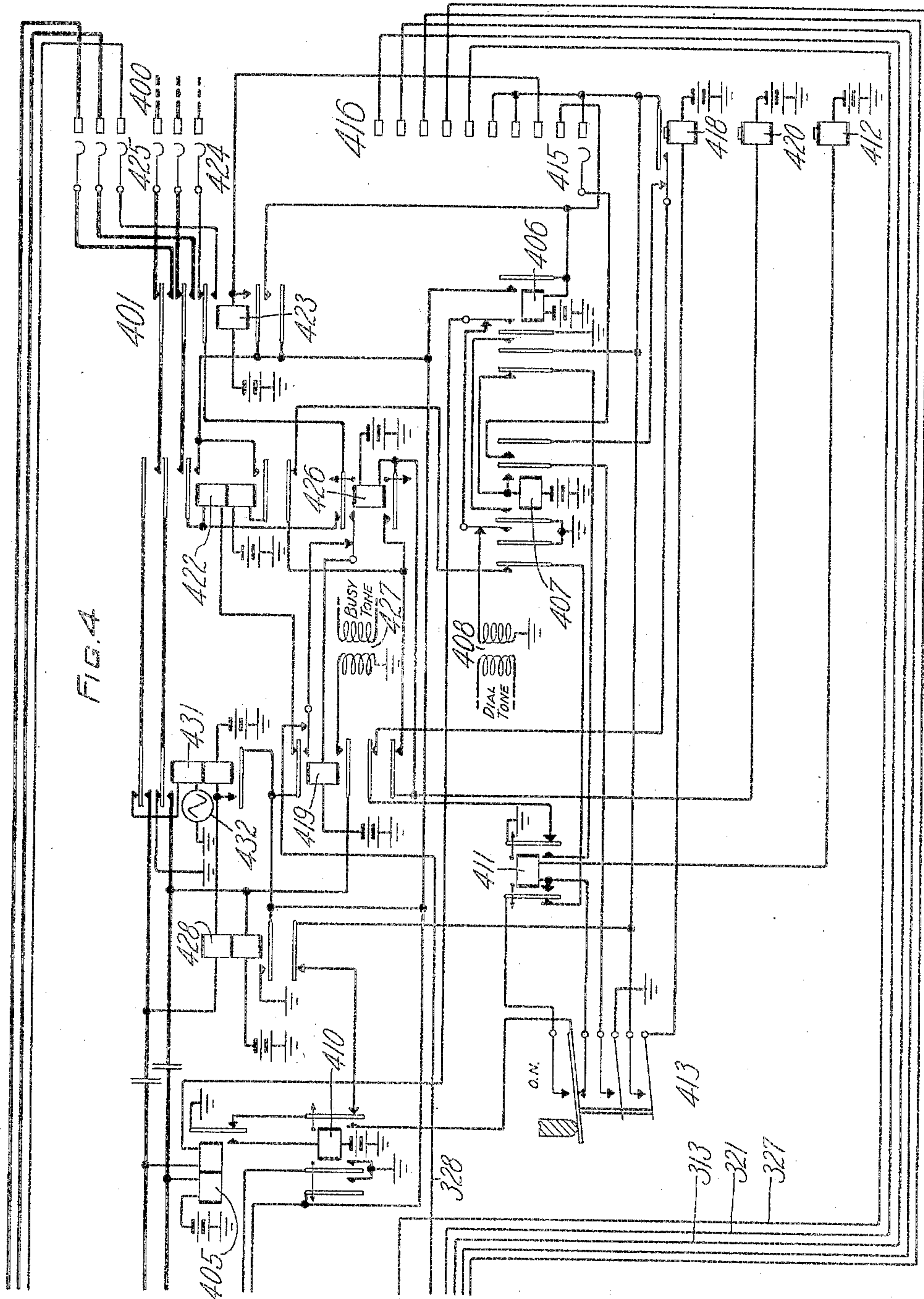
E. E. HINRICHSEN

1,738,245

TELEPHONE SYSTEM

Filed Nov. 1, 1928

5 Sheets-Sheet 5



INVENTOR
E. E. HINRICHSEN
BY *Wm. McKenney*
ATTORNEY

UNITED STATES PATENT OFFICE

EDWARD E. HINRICHSSEN, OF NEW YORK, N. Y., ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

TELEPHONE SYSTEM

Application filed November 1, 1923. Serial No. 316,432.

This invention relates to telephone systems and particularly to improvements in automatic switching systems.

An object is to simplify the equipment used in small capacity automatic switching systems such as private branch exchange systems and to economically employ switches by utilizing them in the establishing of different types of connections without detracting from their normal capacity and utility.

Another object of the invention is to maintain the operation and the equipment of the same simplified nature, while increasing the capacity of the system.

Heretofore, in the establishing of different types of connections in systems of this type, a calling subscriber's line is first extended through a line finder and a link circuit to a connector. If then, a certain impulse code is received this original connection is released and a trunk line finder engaged to extend the connection to an idle trunk while if a usual series of impulses is received the original connection is further extended through the connector.

According to one feature of the present invention the switches are more economically employed in that the original extension of the calling subscriber's line through a line finder and a link circuit to a connector, is retained regardless of the type of connection desired from this point. If a special impulse code is received, the connector is actuated as a marker switch to cause the trunk line finder or hunting switch of an idle trunk to connect said trunk to the link circuit, whereupon the connector is released; while if a usual series of impulses is received the connector is actuated to extend the connection therethrough in the usual manner. The arrangement is such that the normal capacity of the connector for extending the usual connections therethrough is not decreased by the use of the connector as a marker switch.

Another feature of the invention is an arrangement whereby the trunks may be divided in groups leading to different points and the connectors actuated to mark the particular group in which the hunting switch of an idle trunk shall be actuated.

Another feature of the invention is an arrangement whereby connections may be made from a trunk to a called subscriber's line. In this case the hunting switch of the seized trunk is actuated to hunt for an idle link circuit, whereupon the associated connector may be actuated by incoming impulses to select the desired subscriber's line, while the line finder associated with the seized link circuit is made busy.

Another feature of this invention is the provision of means for increasing the capacity of an exchange. Additional groups of subscribers' lines may be equipped in the same manner as the first group except that the terminals of the additional connectors are multiplied to the first group of subscribers' lines. Extra groups of hunting switches are also added having access to all the links in the system. The brushes of each group of such hunting switches are connected through links to auxiliary connectors, the terminals of which are in turn multiplied to the subscribers' lines of a particular group.

By this arrangement, a subscriber in the first group may be connected to a subscriber in any one of the other groups by the dialing of a certain code. This certain code causes an idle one of the extra hunting switches, in the group having access to the particular group of subscribers among which the wanted subscriber's line may be found, to be actuated to find the link with which the calling subscriber's line is associated. The calling subscriber may then proceed to dial the wanted subscriber's number and thereby cause the auxiliary connector associated with the seized hunting switch and link to be actuated to find the wanted subscriber's line. Similarly, if a subscriber in a second or a third group desires to establish a connection with a subscriber in another of the additional groups the procedure is the same. If a subscriber in an additional group desires to call a subscriber in the first group, a regular connector, associated with a link and line finder through which the calling subscriber has been extended, is actuated to select the wanted subscriber's line.

This invention has been illustrated in the

accompanying drawings, in which Fig. 1 shows in diagrammatic form the arrangement for extending connections from several groups of subscribers' lines at a private branch exchange;

Figs. 2, 3, 4, 5 and 6 illustrate the detailed circuits for one group of subscribers' lines from which connections may be made;

Fig. 7 shows how Figs. 2 to 7 may be arranged for reading in connection with the specification.

Referring now to Fig. 1, this figure illustrates a typical grouping of subscribers' lines in a private branch exchange, arranged in accordance with this invention. Three groups of subscribers' lines have been shown; groups 1, 2 and 3, each of which may comprise 200 lines. These lines terminate in jacks at the private branch exchange operator's position; group 1 in jacks 4; group 2 in jacks 5 and group 3 in jacks 6. These groups of lines also terminate in line finders at 7, 8 and 9, respectively. The line finders are connected to groups of link circuits at 10, 11 and 12, connected respectively to groups of connector switches at 13, 14 and 15. These connector switches have access to the subscribers' lines in group 1, hence a connection from a subscriber in groups 1, 2 or 3 to a subscriber in group 1 will extend over a line finder in groups 7, 8 or 9, a link in the groups 10, 11 or 12 and a connector in groups 13, 14 or 15. These three groups of connectors 13, 14 and 15 are further arranged as marking switches for causing hunting switches such as groups 16 to 22 to be actuated to extend connections from the subscribers in these three groups to various points as will be explained hereafter.

For example, if a connection is desired from a subscriber in group 1 to a subscriber in group 2 the connection is extended over a line finder in group 7, a link in group 10 and a connector in group 13. The connector now acts as a marking switch to cause an idle trunk hunting switch 16 or 17 to be actuated to find the link in group 10, to which the calling subscriber of group 1 is connected. Hunting switches 16 to 19 are associated with auxiliary groups of connectors 23 to 26. A connection will therefore in this case be further extended through an auxiliary connector 23 or 24 to the desired subscriber's line in group 2. If a connection is desired from a subscriber in group 1 to a subscriber in group 3 the procedure is the same except that a hunting switch 18 or 19 is actuated to find the link in group 10, to which the calling subscriber is connected and further extended through an auxiliary connector 25 or 26 to the wanted subscriber in group 3.

In establishing a connection from a subscriber in any one of the groups 1, 2 or 3 to a subscriber in group 1 a three-digit number is used by the calling subscriber. The first number is in this particular arrange-

ment either the numeral 2 or 3. The numeral 2 will select the first group of one hundred lines and the numeral 3 the second group of one hundred lines. This first digit therefore determines in which group of one hundred lines the called subscriber's line is located. The second and third numerals may be any one of the numbers from 1 to 0, the selection of the calling line being in this case made by a connector in either of the groups 13, 14 or 15, the connector serving in such a connection only as a connecting switch. If a connection is desired from a subscriber in groups 1, 2 or 3 to a subscriber in group 2 or 3, a four-digit number is used by the calling subscriber. The first digit causes the corresponding connector in group 13, 14 or 15 to act as a marker and extend the connection to an auxiliary connector, the second digit causes the operation of the auxiliary connector to select the group of one hundred lines in which the desired subscriber is located, and the third and fourth digits select the wanted subscriber's line.

Access may also be had from a subscriber in groups 1, 2 or 3 to the private branch exchange operator's position. If such a connection is desired a connector in groups 13, 14 and 15 will act as a marker to cause a hunting switch in group 20 to connect with the calling subscriber through the associated link circuit and establish a connection to the private branch exchange operator over a trunk in group 28, terminating in a jack at the private branch exchange operator's position 29.

A connection may also be had, from groups 1, 2 or 3, over hunting switches in group 21, to a tie-line in group 30, said group of tie-lines leading to other private branch exchanges. In this case the connector in groups 13, 14 or 15 will act as a marker to cause an idle switch of group 21 and the associated trunk in group 30 to be selected.

The circuits of this invention are further arranged so that calls incoming over trunks in group 30 may be extended to a desired subscriber in groups 1, 2 or 3. In this case when a trunk in group 30 is taken for use the associated hunting switch in group 21 hunts for an idle link circuit of any of the links in groups 10, 11 or 12 and when connected thereto the incoming impulse will actuate the associated connector in groups 12, 13 or 15 in the same manner as when a calling subscriber in any of the groups 1, 2 and 3 desires a connection i. e. the associated connector will act as a marker if the wanted subscriber is located in group 2 or 3, or merely as a connector if the wanted subscriber is located in group 1.

Similarly connections may be extended from subscriber in groups 1, 2 or 3 to distant central offices over trunks in group 32. In this case the trunk hunting switch 22 extends

the connection from the selected link circuit over an idle trunk in group 32, the associated connector acting as a marking switch.

It should be understood that, while the connections for only three groups of private branch exchange subscribers have been shown, additional groups may be added without any extensive changes in the circuit arrangement. For example, if an additional group is desired, line finders will be provided therefor to connect with the links and their associated connectors multiplied to subscribers' lines in group 1. These links would be provided with hunting switches and auxiliary connectors for connecting with subscribers in that group.

It will be noted that the line finders and connectors which are of the Strowger step by step type, have been shown in pairs. This indicates that these switches are of the type well known in the art having 200 line connections arranged in 20 levels with 10 line connections in each level, and two sets of brushes, one set of brushes for association with any line in one group of 100 lines and the other set of brushes for association with any line in the second group of 100 lines. Said sets are moved together when the switch is actuated and through circuit arrangements one or the other of these sets may be selected for connection with the desired line in the desired group.

Referring now to Figs. 2 to 6, descriptions will be made in connection with these drawings of calls over a subscriber's line from station A to a subscriber in the same group over terminals such as 400 in Fig. 4, to a private branch exchange operator at 500 in Fig. 5, to another private branch exchange over a trunk 600 in Fig. 5, and to a distant central office over trunk 700 in Fig. 6. Description will also be made of a call from a distant private branch exchange over trunk 600 to the subscriber at station A. The circuit arrangement shown in Fig. 3 has only been completed through a hunting switch 502 and the associated trunk 501 to the private branch exchange operator's position 500, and through a hunting switch 602 and the associated tie-line trunk 600 to a distant private branch exchange. Connections to hunting switches of the type described in Fig. 1 have however been indicated in Fig. 3 at 302, 303 and 304 for extending calls to other groups of subscribers in the same exchange, or to trunks to central offices. The central office trunks are similar to the trunk 501 and hereinafter it will be explained how calls may be extended over such trunks, one of which is shown by the left hand portion of Fig. 5 and Fig. 7. Connections to other groups of subscribers' lines will also be explained with the aid of Figs. 2 to 6.

The first connection to be explained will be one extending from the subscriber at station A to a subscriber in the same group over ter-

minals at 400 in Fig. 4, through line finder 201 and connector 401. When the calling subscriber at station A removes the receiver from the hook a circuit is completed for the operation of relay 202, from battery and ground through the windings of relay 202 and armatures and back contacts of relay 203. Relay 202 in operating establishes a connection for the cut-off relay 203 to the sleeve terminal of switch 201 and a circuit for the operation of the group relay 204. This relay is common to a group of 20 lines, that is, one group of 10 in each of the groups of 100 lines terminating in switch 201, in corresponding levels. Relay 204 in operating grounds a segment in the vertical commutator 205 of the line finder 201 to indicate the level in which the calling subscriber's line is located. The battery connection on the sleeve terminal of the line of station A identifies this line to the brushes for the group of 100 lines in which the subscriber's line is included. The two sets of brushes of switch 201 are marked 208 and 209 respectively.

The line finder 201 will now be actuated to find the calling subscriber's line. To this end relay 204 in operating closes a starting circuit for the operation of the start relay 210 over a circuit as follows: battery, winding of relay 210, second lower armature and back contact of relay 211, lower outer armature and front contact of relay 204, to ground at the armature and back contact of group busy relay 206. The arrangement of the start circuit is such that one of the line finders is the first choice. If line finder 201 is busy the start circuit is extended through contacts of relays 211 and 212 over lead 227, to a second choice line finder, which is not shown. Relay 210 in operating connects ground at its lower inner armature and front contact to lead 213, to make the link 207 busy as will hereinafter be described. The operating circuit for the release magnet 215 is opened by the operation of relay 210 at the upper outer armature and back contact. A test circuit is completed to group-test brush 216 at the inner upper armature and front contact, and a circuit is closed for the operation of relay 217 as follows: battery, upper winding of relay 217, inner upper armature and back contact of the rotary magnet 218, armature and back contact of vertical magnet 219, lower outer armature and back contact of relay 211, to ground at the lower outer armature and front contact of relay 210. Relay 217 in operating closes a circuit for the operation of the vertical magnet 219 as follows: battery, winding of vertical magnet 219, lower middle armature and back contact of relay 212, armature and front contact of relay 217, to ground at relay 210. The vertical magnet in operating steps both sets of brushes up to the first level and causes the release of relay 217 by the opening of the connection through its

armature and back contact. The closing of the off-normal contacts connects ground to lead 213. Relay 217 in releasing causes the release of vertical magnet 219 and this in turn causes the operation of relay 217. Relay 217 and vertical magnet 219 now operate and release alternately until brush 216 reaches the contact in the commutator 205 representing the level in which the calling subscriber's line is located. At this time brush 216 encounters ground from the upper armature and front contact of relay 204. Relay 217 is thereby held operated over a circuit from battery through the upper winding of relay 217, upper inner armature and back contact of rotary magnet 218, upper winding of relay 212, upper inner armature and front contact of relay 210, brush 216, the proper contact in commutator 205, upper inner armature and front contact of relay 204, to ground. Relay 212 operates in series with relay 217 over the above circuit and provides a locking circuit for itself in series with the winding of the vertical magnet 219 as follows: battery, winding of vertical magnet 219, lower winding of relay 212, lower inner armature and front contact of this relay, to ground at relay 210. The original circuit for the vertical magnet is now open, so under these circumstances it will release as it does not receive sufficient current with relay 212 in its circuit.

Relay 212 in operating places the rotary magnet 218 under control of relay 217 and this relay and rotary magnet will now operate and release alternately until brushes 208 or 209 find battery on a sleeve terminal. The circuit for the rotary magnet may be traced from battery through the winding of this magnet, lower middle armature and front contact of relay 212, armature and front contact of relay 217, to ground at relay 210. When the rotary magnet operates relay 217 is released, but when battery is encountered on the sleeve of the calling subscriber's line this relay is held operated thus preventing further operation of the rotary magnet. The holding circuit for relay 217 extends from battery through the winding of the cut-off relay 203, upper armature and front contact of relay 202, sleeve terminal of the calling subscriber's line in line finder 201, and, if it is assumed that the calling subscriber's line terminals are located in the first hundred line group, through the sleeve brush of the set 208, upper winding of relay 221, second lower armature and back contact of relay 222, lower winding of relay 217 to ground at relay 210. If the calling subscriber's line terminals had been located in the second group of 100 lines the battery connection would have been supplied through the sleeve brush of the set 309, the upper winding of relay 222, second lower armature and back contact of relay 221, upper armature and back contact

of relay 211, and lower winding of relay 217, to ground at relay 210.

If two subscribers whose lines terminate in the same position in the same level but in the two different groups of 100 lines are calling simultaneously both relay 221 and 222 might operate, but relay 221 will open a holding circuit for relay 222 so that relay 221 only will be operated, thus giving preference to the calling subscriber's line located in the first group to which brushes 208 has access. Relays 203 and 221 operate in the holding circuit for relay 217. Relay 203 locks through its own upper inner armature and front contact, causes the release of relay 202, extends the talking conductors from the calling subscriber's line to link 207, and makes the jack 223 busy. Relay 221 is energized sufficiently by the current through its upper winding to close its inner lower armature and front contact, thereby causing its own complete operation in a circuit from battery through its lower winding, its lower inner armature and front contact, upper outer armature and front contact of rotary magnet 218 through lead 224, inner right hand armature and make-before-break contacts of relay 306 to ground over relay 213 at relay 210. Relay 221 in operating connects the wipers 208 of the switch 201 to the link 207 at its upper armatures and front contacts.

Relay 221 also closes a circuit for the operation of relay 211 as follows: battery, upper winding of relay 211, lower outer armature and front contact of relay 221, to ground at the off-normal contacts 226. Relay 211 provides a locking circuit for itself from battery through its lower winding, lower inner armature and front contact, over the start lead, to ground at relay 206. This circuit is not used unless relay 204 is operated by another subscriber's line relay and this line finder is released during the period that the ground on the start lead is needed for the seizing of another line finder as will hereinafter be described. It should be noted that ordinarily relay 204 will by this time be released due to the release of line relay 202. Relay 211 in operating opens the start lead connection for relay 210 and connects ground from lead 224, through the upper armature and front contact of relay 211, lower middle armature and front contact of relay 221, to the sleeve brush 208. This is a busy ground for the calling subscriber's line. The release of relay 210 causes the release of relay 217 and rotary magnet 218, the circuit for relay 217 being opened at the outer lower armature of relay 210 and the circuit for the rotary magnet being opened at the armature and front contact of relay 217. Another locking circuit is now closed for relay 221, independent of the connection hereinbefore traced through the upper outer armature and front contact of the rotary magnet 218. This circuit may be traced from

battery through the lower winding of relay 221, lower inner armature and front contact of this relay, the third lower armature and front contact of relay 211, to ground on lead 224. Relay 210 in releasing also causes the release of relay 212 by opening the locking circuit for relay 212 to ground at the lower armature and front contact. Relay 212 in releasing connects the tip and ring conductors of trunk 207 to brushes 208 at the make-before-break contacts of this relay.

The start circuit is now extended from the second lower armature and front contact of relay 211, and lower outer armature and back contact of relay 212, to the next line finder over lead 227. During the interval that relays 202 and 212 were operated, the tip conductor of the calling line, was connected to lead 229, for the operation of relay 307, over a circuit from battery through the winding and make-before-break contacts of this relay, lead 229, upper outer armature and front contact of relay 212, tip conductor of trunk 207, tip brush of group 208, tip terminal of the calling subscriber's line, lower outer armature and front contact of relay 202, and through the lower winding of this relay, to ground. Relay 307 operates, opens this circuit and closes a locking circuit for itself to ground over lead 224. The purpose of this relay is to distinguish between different classes of calling subscribers' lines such as unlimited and restricted service lines. In this case the subscriber of the calling line is considered as a restricted service subscriber, that is, a subscriber not entitled to extend connections to central offices. The effect of the operation of relay 307 will be explained hereinafter.

It will be noted that at the operation of relay 212, hereinbefore described, a circuit was prepared for the operation of line relay 405 of the connector 401 shown in Fig. 4. This circuit may be traced as follows: battery, left hand winding of relay 405, ring conductor of trunk 207, upper inner armature and back contact of relay 310, inner upper armature and front contact of relay 212, resistance 230, tip conductor of trunk 207, the upper outer armature and back contact of relay 310, right hand winding of relay 405, make-before-break contacts of relay 406, make-before-break contacts of relay 407, one winding of the repeating coil 408, to ground. Relay 405 in operating causes the operation of relay 410 and this relay causes the operation of relay 306, which in turn transfers the holding ground for relays 202 and 221 to the ground at relay 410 and also connects this ground to lead 213 for a purpose which will become apparent as the description proceeds.

When relay 212 releases, as hereinbefore described, it connects trunk 207 to the calling subscriber's line. Dial tone applied through

the repeating coil 408 over the ring conductor will now be heard through the calling subscriber's receiver, indicating that the connector in Fig. 4 is ready to receive dial pulses for the desired connection.

Depending now on what type of connection is desired, the connector will be operated, either as a marking switch to extend the connection through a hunting switch to any of the points mentioned in connection with the description of Fig. 1, or as a regular connector to select a calling subscriber's line in the first group of 200 subscribers in this private branch exchange. To establish connections of these kinds various code numbers have been assigned. If the subscriber dials digit 2, the wanted subscriber is located in the first sub-group of 100 of the first group of 200 subscribers. If the digit 3 is dialed, the subscriber is located in the second sub-group of 100 of the first group of 200 subscribers. When the subscriber dials any digit from 1 to 0 as the second digit the connector switch will be actuated to select the proper group of 10 in which the wanted subscriber's line is located, and when any digit from 1 to 0 is dialed as the third digit the connector will be actuated accordingly to connect with the corresponding wanted subscriber's line in the desired level. On the other hand, if the first digit dialed is 4 or 5, the connector is returned to normal since in this particular arrangement the digits 4 and 5 are not used. These digits are therefore eliminated as a first digit in any coded numbers that the calling subscriber may dial. If the first digit is 6, 7, 8, 9 or 0 the connector will be actuated to act as a marker switch and select a connection through the circuits of Fig. 3 to the desired corresponding destination as outlined in connection with the description as per Fig. 1. These various connections will be described hereinafter in more complete detail.

If, for example, a subscriber is wanted that is located in the first sub-group of 100 lines in the group of 200, the subscriber will dial 2. The first impulse releases relay 405 and thus causes a circuit to be closed, for the operation of relay 411 and the vertical magnet 412, from battery through the windings of the magnet and relay in series, through normally closed contacts of off-normal contacts 413, right hand armature and front contact of relay 410, armature and back contact of relay 405, to ground. Magnet 412 causes the connector 401 to step its brushes up to the first level, thereby placing brush 415 in contact with the first terminal of the commutator 416. The operation of relay 411 closes a circuit, for the operation of relay 407, from battery through the winding of this relay, outer left hand armature and back contact of relay 406, right hand armature and front contact of relay 411, to ground. When the

brushes are stepped up to the first level, the off-normal contacts 413 are operated and the original circuit for vertical magnet 412 and relay 411 now extends through the right hand armature and front contact of relay 411 and closed contacts of the off-normal contacts 413, to ground at relay 405. When relay 405 operates after the first impulse the vertical magnet 412 is released, but relay 411 is slow to release and remains operated during the second impulse. Relay 407 is locked in operated position through its inner right hand armature and front contact, to ground through closed contacts of off-normal contacts 413. The second impulse again operates the vertical magnet 412 and advances the brush 415 to the second terminal of commutator 416. At the end of this impulse relay 411 releases with the vertical magnet. Relay 406 is now operated over a circuit from battery, winding of this relay, second contact of commutator 416, brush 415, outer right hand armature and front contact of relay 407, make-before-break contacts of the release magnet 418, second lower armature and back contact of relay 419, right hand armature and back contact of relay 411, to ground. Relay 406 in operating closes a circuit for release magnet 418 from battery through the winding of this magnet, closed contacts of off-normal contacts 413, second left hand armature and front contact of relay 406, inner left hand armature and front contact of relay 407, to ground. Relay 406 also opens the dial tone circuit and provides a locking circuit for itself, through its right hand armature and front contact to ground at the outer left hand armature and front contact to relay 410, so this relay will remain operated during the succeeding operations of the switch. When the switch returns to normal, due to the operation of the release magnet, relay 407 is released by the restoring of the off-normal contacts 413 to normal and it will be noted that relay 407 will not be operated during the succeeding operations of the switch as the original connection therefor through the outer left hand armature and back contact of relay 406 is broken.

The switch having been returned to normal will now be again operated by the second number dialed, which may be any one of the digits 1 to 0. In this case the circuits for the vertical magnet and relay 411 will be controlled by the second digit in the number called in the same manner as hereinbefore described, and advance the brushes of switch 401 to the desired level.

When the brushes of the switch 401 have reached this level and relay 411 is released, the release of relay 405, in response to the first impulse of the last digit of the code number, completes a circuit for operating the rotary magnet 420 from battery through the

winding of this magnet, lower outer armature and back contact of relay 419, lower outer armature and back contact of relay 422, outer left hand armature and back contact of relay 407, left hand armature and back contact of relay 411, closed contacts of off-normal contacts 413, right hand armature and front contact of relay 410, armature and front contact of relay 405, to ground. This will advance the two sets of brushes 424 and 425 of the connector 401 to engage the corresponding terminals of the first line in the selected level, but, as relay 423 is not operated at this time, only the set of brushes 424 will be actively engaged. The succeeding impulses received from the calling subscriber will operate the rotary magnet 420 to select the terminals of the desired line in this level, for example line 400.

Relay 426 is also operated at the first operation of rotary magnet 420 from battery through the winding of this relay to the ground at relay 405 as hereinbefore traced for the rotary magnet. Relay 426 is slow to release so that it will remain operated during succeeding operations of the rotary magnet 420. The operation of this relay disconnects the sleeve brush of the set of brushes 424 from the upper winding of relay 422 and connects it through to the winding of relay 419. The closing of the lower armature and front contact of relay 426 makes the operating circuit of this relay independent of the lower armature and back contact of relay 419 so as to prevent the release of relay 426 if the test brush engages the terminal of a busy line during the advance of the brushes to the terminals of the called line.

When this last series of impulses is completed relay 426 releases and if the called line is busy at this time relay 419 will operate from ground on the sleeve terminal of this busy line and will remain locked under control of relay 410. The locking circuit for relay 419 may be traced from battery through the winding of this relay, make-before-break contacts of relay 426, upper armature and front contact of relay 419 to ground at relay 410. With relay 419 operated and relay 426 released the circuit for the test brush of the group 424 is opened and the switch is disabled for further movement. A busy tone from the source 427 will be applied to the ring conductor of trunk 207 to notify the calling subscriber that the line is busy. When the calling subscriber hangs up his receiver relay 405 is released, releasing relay 410. Relay 306 is thus released and the busy and holding ground is disconnected from lead 224 so that relays 203 and 221 release. The line finder and connector are both restored to normal. The circuit for the release magnet 418 of the connector is closed from battery through the winding of the off-normal contacts 413, lower outer armature and back

contacts of relay 428, right hand armatures and back contacts of relays 410 and 405, to ground. The circuit for the release magnet 215 of the line finder is from battery through its winding, off-normal contacts 226, back contacts of relays 210, 222 and 221, to ground at the off-normal contacts 226.

If, however, the called line is free relay 419 is not operated and relay 426 released, this relay in releasing establishes a connection for the test brush of group 424 to ground through the upper winding of relay 422, upper armature and back contact of relay 419 and outer left hand armature and front contact of relay 410. Relay 422 operates in series with the cut-off relay of the called subscriber's line and closes the circuit of its holding winding, which extends from battery through its lower winding, lower inner armature and front contact, outer left hand armature and front contact of relay 410, to ground. Relay 422 in operating also establishes a direct connection to ground for the test brush of the group 424 through the upper armature and back contact of relay 426, upper inner armature and front contact of relay 422, to ground at the outer left hand armature and front contact of relay 410. Relay 422 also extends the tip and ring brushes of the group 424 to the ringing circuit through the upper armatures and back contacts of ringing relay 431, and opens the circuit for the rotary magnet 420 and the relay 426 to disable the switch for further movement. Ringing current is now applied from the source 432 through the upper winding of the ringing relay 431 over the tip conductor to the called subscriber's line and back over the ring conductor to ground.

When the called subscriber answers the increase in current in the upper winding of relay 431 is sufficient to operate this relay to close a locking circuit from battery through the lower winding, lower armature and front contact, to ground at the outer left hand armature and front contact of relay 410. This locking circuit completes the operation of ringing relay 431 and the connection for the called subscriber to the tip and ring conductors is now completed to trunk 207. This connects the two lines together for conversation, talking current being supplied to the called subscriber through relay 428, the circuit being from battery through the lower winding of this relay, to the ring conductor and back over the tip conductor through the upper winding, lower armature and front contact of relay 431, to ground at relay 410. Relay 428 operates and supplies a ground connection for its circuit independent of relay 410 and opens the release circuit.

When the calling subscriber hangs up, relay 405 is released, causing the release of relay 410. This relay causes the release of the line finder (Fig. 2) by removing ground from leads 224, which causes the release of relay

221 and the operation of release magnet 218 over a circuit from battery through the winding of this magnet, off-normal contacts 226, upper outer armature and back contact of the start relay 210, lower armatures and back contacts of relays 222 and 221 in series, to ground at the off-normal contacts 226. When the release magnet has operated and the line finder is returned to normal this circuit is opened at the off-normal contacts 226. The ground being removed from conductor 224 causes the cut-off relay 203 of the calling subscriber's line to release and also the release of relay 306. In case the start lead is grounded at this time, relay 211 is held operated until this ground is removed, in order to prevent interference with the line finder under control thereof. If the called subscriber has not yet hung up, ground is maintained on lead 213 by the connection through the make-before-break contacts of relay 306, and the inner lower armature and front contact of relay 428 to hold relay 211 operated and thus prevent the line finder 201 from being operated until trunk 207 is finally released at the connector end.

When the called subscriber hangs up, relay 428 is released, causing the release of relay 211 if not held up by ground on the start lead and also the release of all the other relays, such as relays 431, 406 and 422. A circuit is also closed for the release magnet 418 as follows: battery through the winding of this magnet, off-normal contacts 413, outer lower armature and back contact of relay 428, right hand armatures and back contacts of relays 410 and 405, to ground. When the connector is restored to normal the off-normal contacts 413 release opening the circuit for the release magnet.

Referring now to the extension of connections in which the connector is used as a marking switch, the extension of a connection to the P. B. X. operator's position 500 will be explained. This connection corresponds to a connection to position 29, Fig. 1, hereinbefore described. The circuits shown in Fig. 3 and Fig. 5 are used for extension of connections of this type. In this particular case the calling subscriber will dial a code number which, according to the arrangement of the connector, is number 9. In dialing this number the connector will be operated to advance the brush 415, over the commutator 416 to the 9th terminal. When this terminal is reached a circuit will be completed for the operation of relay 312 which is the relay for extending the connection to position 500. This circuit may be traced as follows: battery, left hand winding of relay 312, lead 313, the 9th terminal of commutator 416, brush 415, outer right-hand armature and front contact of relay 407, make-before-break contacts of release magnet 418, second lower armature and back contact of relay 419, right hand armature and

back contact of relay 411 to ground. Relay 312 now operates to remove the ground from the test lead 314 and the corresponding terminal of hunting switch 502 and to close the start lead 315 to ground at the lower armature and back contact of relay 310. The test lead 314 is connected through the holding winding of relay 312 and the winding of relay 310 to battery.

The terminals of hunting switches, such as 502, will now test idle and the start relay of the first choice hunting switch, for example, switch 502 and start relay 504, will operate from battery, through the winding of this relay, outer left hand armature and back contact of relay 505, start lead 315, inner left hand armature and front contact of relay 312, to ground at the lower armature and back contact of relay 310. The hunting switch 502 and others in the same and other groups are of the single motion rotary switch type having no normal position. Switch 502 is connected to link 501 terminating in jack 516 at the operator's position 500. Relay 504, in operating, closes a circuit for the stepping magnet 506 through the winding of this magnet and its self-interrupting contacts, outer left hand armature and front contact of relay 504, lower outer armature and back contact of relay 507, to the test brush of switch 502. Another circuit for magnet 506 is completed through the winding of relay 507 to ground at the inner left hand armature and front contact of relay 504. If the brushes of switch 502 are at the time resting on the terminals of another connection to a circuit such as shown in Fig. 3 ground will be encountered on the test lead corresponding to lead 314 at the right hand armature and back contact of the relay corresponding to relay 312 so that the stepping magnet 506 will be operated to advance the brushes of switch 502 to the terminals of the next connection. This operation is repeated as long as the sleeve brush of switch 502 encounters ground on succeeding sets of terminals.

When the calling line is found there is no ground on test lead 314 so that magnet 506 will not operate further and the switch stops with its brushes in contact with the calling line. The ground applied through relay 507 will now cause relay 507 to operate whereas magnet 506 will not receive sufficient current for operation. The original connection for the magnet 506 to the test brush of switch 502 is thereby opened at the lower outer armature and back contact of relay 507. Relay 507 in operating closes a connection, from ground at the start relay 504, through its outer lower armature and front contact to the test brush of switch 502 so that relay 310 will now operate, over a circuit from battery, through the winding of relay 310, right hand winding and right hand armature and front contact of relay 312, test lead 314, test brush of switch

502, to this ground. Relay 312 holds in this circuit and relay 310 opens the connection through trunk 207 leading to the connector in Fig. 4 so that the connector will now be released by the release of relay 405 in the manner hereinbefore described. The release of the connector would ordinarily release relay 306 and cause the release of the line finder in Fig. 2 but relay 310 in operating closes a holding circuit for relay 306 so as to prevent its release and the release of the line finder. Relay 310 also opens the start circuit at its lower armature and back contact.

The connection will now therefore be extended from the calling subscriber over a portion of trunk 207, tip and ring conductors 317, switch 502, the upper and lower inner armatures and front contacts of relay 507, make-before-break contacts of relay 509, and windings of relay 510, to battery and ground. Relay 510 is therefore operated at this time through the calling subscriber's loop and in operating provides a ground connection at its left hand armature and front contact for holding relay 507 operated, as it will be noted that when relay 310 operated to open the start circuit, relay 504 was released. Relay 505 was operated over an obvious circuit through the operation of relay 507, so that the start lead 314 is now extended through the outer left hand armature and front contact of relay 505 to the next switch. The start lead extension is marked 512. In this manner relays 507 and 505 are now held under control of relay 510. Relay 510 in operating closes an obvious circuit for lighting of lamp 515 to indicate to the P. B. X. operator that a connection is desired over this circuit.

When the operator answers this call by inserting plug 515 into jack 516, relay 509 is operated over an obvious circuit through jack springs closed at this time; and this opens the circuit for the lamp 513 which is extinguished and also opens the connections through the windings of relay 510 from the calling subscriber. The connection from the calling subscriber is now extended over the tip and ring terminals of jack 516 and plug 515 through the windings of relay 517 to battery and ground and this relay in operating prevents the lighting of supervisory lamp 518. The connection from this point on is of no importance as far as this invention is concerned. It is sufficient to say that the connection may be extended to the P. B. X. operator's telephone set and conversation between the calling subscriber and this operator may begin. Talking current for the calling subscriber is supplied through the windings of relay 517. It should be noted that relay 510 is not released at this time but held operated through contacts of relay 509 and this relay in turn holds the relays 507 and 505 operated. It should be mentioned here that

if all of the hunting switches in this group are busy the start lead extension of the last switch in the group corresponding to extension 512 is connected to lead 330. Consequently, if a call is made under these circumstances ground over the lead 315 will be supplied through a circuit closed through the outer left hand armatures and front contacts of all relays corresponding to relay 505, lead 330, outer left hand armature and front contact of the relay corresponding to relay 312 in the link circuit through which the call is made, the conductor corresponding to conductor 328, make-before-break contacts of the relays corresponding to relays 419 and 426 the winding of the relay corresponding to relay 419 to battery, causing this relay to operate and apply busy signal to the calling line.

When the operator disconnects, relay 509 is released and if the calling subscriber hangs up relays 510, 507 and 505 are also released. The ground is thereby removed from the test brush and relays 310 and 312 are released. Relay 310 releases relay 306 which in turn causes the release of the line finder as hereinbefore described.

Referring now to a connection from a calling subscriber, to the tie-line as shown in Fig. 6, this subscriber will operate a connector as hereinbefore described to advance it in a vertical direction to position 10. This is the position in which the connector will act as a marking switch to establish connections to tie-lines corresponding to the group 30 in Fig. 1. In this case a circuit will be completed for the operation of relay 320 as follows: battery, left hand winding of this relay, lead 321, the 10th contact of commutator 416, brush 415, outer right hand armature and front contact of relay 407, make-before-break contact of release magnet 418, second lower armature and back contact of relay 419, right hand armature and back contact of relay 411, to ground. Relay 320 in operating opens the connection to ground for the test lead 322 and extends it through its own right hand winding and the winding of relay 310 to battery. Relay 320 also establishes a connection for the start lead 323 from ground at the lower armature and back contact of relay 310. This start lead is connected to the start relay 603 of the first choice hunting switch 602. Relay 603 operates and closes an obvious circuit for the operation of relay 608. This relay in operating extends a connection for the tie-line 600, as is obvious over armatures and back contacts of relays 613 and 605, through the windings of relay 610 to battery and ground. This latter relay operates in series with a relay, not shown, but usually bridged across the distant end of the tie-line. An obvious circuit is closed by the operation of relay 610 for the relay 611 which in operating closes a locking circuit for relay 608.

Relay 611 closes a circuit from ground, through its lower armature and front contact, the outer left hand armature and front contact of relay 603, winding of relay 605, self-interrupting contacts and winding of stepping magnet 604, to battery. Another circuit closed through the operation of relay 603 for the stepping magnet 604 may be traced from battery, winding and self-interrupting contacts of this magnet, inner left hand armature and front contact of relay 603, lower outer armature and back contact of relay 605, lower inner armature and back contact of relay 606 to the test brush 624 of switch 602.

If the switch 602 is connected to the terminals of any other line rather than to the one associated with the circuit in Fig. 3, ground will be found on the corresponding test terminal thereof and thus complete a circuit for the stepping magnet 604 to advance it from one set of terminals to another until it reaches the line from the circuit of Fig. 3 the ground having been removed from the test terminal by the above mentioned operation of relay 320. Under these circumstances relay 605 does not operate as it is short circuited by the ground on the corresponding test terminals. When terminal 624 is reached a circuit is established for the holding of relay 320 and the operation of relays 310 and 605 over a circuit as follows: from battery, through the winding of relay 310, right hand winding of relay 320 and right hand armature and front contact thereof, test lead 322, test terminal and brush 624 of switch 602, lower inner armature and back contact of relay 606, lower outer armature and back contact of relay 605, inner left hand armature and front contact of relay 603, winding of relay 605, outer left hand armature and front contact of relay 603, to ground at the lower armature and front contact of relay 611. Relay 605 as stated will now operate but magnet 604 will not operate as its winding is now in series with that of relay 605 to ground at relay 611 and in parallel with that of relay 310 to battery. It will be noted that when relay 605 operates the ground at relay 611 is extended through the lower outer armature and front contact to test brush 624 and through the next to the lower armature and front contact of relay 605 to lock this relay operated under control of relay 611. Relay 310 and relay 605 are thereby held operated from this ground at relay 611 independent of the contacts of relay 603. In these circumstances, as stated, magnet 605 will not operate and switch 602 will come to rest on the terminals of the line associated with the circuit of Fig. 3.

Relay 605 in operating closes obvious circuits for the operation of relays 612 and 613. Relays 605 and 613 connect the calling line through the tip and ring terminals of

switch 602 and through the windings of relay 610 to battery and ground, and relay 613 removes the short circuits for the condensers 615 and 616. Relay 610 will now be held operated from the calling subscriber's line while the holding coil 617 is bridged across the tie-line 600 through the upper armature and front contact of relay 610, and upper inner armature and front contact of relay 613. Relay 612 opens the circuit for and thereby releases the start relay 603 and extends the start lead through lead 619 to the next switch. Relay 611 and, through it, relays 605, 310, 320, 612, 613 and 608 are now under control of relay 610.

At the operation of relay 310 the connector in Fig. 4 releases as hereinbefore described and when the subscriber dials to extend a connection over tie-line 600 to the distant exchange the impulses incoming from the calling subscriber operate relay 610 and these impulses are repeated over the tie-line by the alternate opening and closing of the connection through the bridge holding coil 617. Relay 618 is operated on the first release of relay 610 so as to short circuit the bridge coil 617 during pulsing. Relays 618 and 611 and consequently relays 605, 612, 613 and 608 remain operated during pulsing and all of these relays except relay 618 remain operated during conversation. Relays 618 and 611 are for these purposes made slow-to-release.

When the calling subscriber hangs up his receiver relay 610 is released operating relay 618. Relay 618 opens the holding bridge through coil 617 and the release of relay 610 causes the release of the remaining relays so that the hunting switch circuit now restores to normal. Relay 618 is as stated slow in releasing so that the line is held open long enough to permit the relay at the distant end to release before relay 608 releases and connects relay 621 across the line. On the release of relay 611 ground is removed from the test brush 624 and test lead 322 so that the relays 320 and 310 release and cause the release of relay 306 which in turn causes the release of line finder 302 as hereinbefore described.

If the tie-line 600 is used for incoming calls to the P. B. X., battery and ground connections are applied from the distant end of this trunk causing the operation of relay 621. Relay 621 in operating closes obvious circuits for the operation of relays 606 and 611. Relay 606 closes a locking circuit for itself under control of relay 611 and causes the operation of relay 612 from battery, through the upper winding of this relay, through the upper outer armature and front contact of relay 606 to ground at the lower armature and front contact of relay 611. Relay 612 in operating advances the start lead 323 to the next switch over lead 619.

Apparatus at the distant end of the trunk 600 now functions to remove battery and ground from the line and place a holding bridge across it. Relay 621 is thereby released, causing the operation of relay 603. This relay in turn causes the operation of relay 608. The circuit for relay 603 may be traced as follows: battery, winding of relay 603, outer lower armature and front contact of relay 606, and lower outer armature and back contact of relay 621 to ground. The circuit for the operation of relay 608 is from battery through its upper winding to ground through the right hand armature and front contact of relay 603. Relay 608 locks under control of relay 611.

In operating relay 608 connects the trunk to relay 610 which now operates over a circuit as hereinbefore described. Relay 610 in operating prevents the release of relay 611. Relay 611 is slow-to-release so that it is held up during the interval between the release of relay 621 and the operation of relay 610, and this relay thus keeps the relays 606, 608 and 612 operated. Relay 603 closes a circuit for the stepping magnet 604 and relay 605 to ground at relay 611. If the link circuit, with which switch 602 is connected, is busy this circuit is also closed through the inner left hand armature and front contact of relay 603, the lower inner armature and front contact of relay 606, test brush 623 of switch 602, lead 324, to ground on lead 224 through the contacts of relay 306. If other leads corresponding to lead 324 of other circuits of this kind supply ground said circuits are also busy and not until an idle circuit is encountered will the ground be removed. The switch 602 will therefore hunt for the first idle circuit in the manner described for an original call except that in this case a test is made over brush 623 instead of brush 624 as relay 606 is operated. When the idle circuit is found relay 605 operates and connects the trunk 600 directly to a connector switch and disconnects relay 610 at the trunk.

It will be noted that on the connection of the trunk 600 to the connector relay 405 operates over the talking leads from trunk 600 and this in turn operates relay 410 which supplies ground over lead 324 making this particular circuit busy to other incoming connections over switches like 602. This ground also keeps relays 605, 608, 606 and 612 operated. Relay 606 holds relay 603 operated so that all these relays are now not dependent on the holding ground of relay 611 which is released on the release of relay 610.

The operation of relay 306 causes the operation of relay 211 over lead 213 so as to make the line finder busy and to advance the line finder start wire to the next line finder. The calling subscriber of trunk 600 may now operate the connector to either act as a marker switch to select a wanted subscriber in the sec-

ond or third group or to select a wanted subscriber in group 1 in the manner hereinbefore described. When the calling subscriber hangs up his receiver relays 405 and 410 release and ground is removed from lead 324 causing the release of the relays 603, 605, 606 and 608 in the circuit of trunk 600, restoring it to normal. In case the start lead 323 is grounded at the time the circuit is released, relay 612 is maintained operated to prevent interference with the operations of other switches.

The next type of connection that may be extended from this P. B. X. is the one leading to a central office. A connection of this type may be reached by dialing number 6 on the part of a calling subscriber. Connections are now established as hereinbefore described over commutator 416 and in this case relay 325 is operated over lead 327. This relay in operating prepares connections over leads 304 to a switch similar to switch 502 which starts hunting for the link which is thus marked by the removal of ground from the test lead. The circuits for this switch are identical with the circuits for switch 502 and trunk 501 up to the line marked 6—6. From this point on it is arranged according to Fig. 6 and the operations for extending a connection over a trunk such as 700 are identical with the operation for the circuit of relay 501 up to this point. Relay 701 is operated in the same manner as relay 510. When this relay operates a connection is extended from ground at the inner left hand armature and front contact of relay 701, through the outer upper armature and back contact of relay 702, to the tip conductor of trunk 700. This ground connection establishes a signal at the distant central office and in any well known manner. Then the operator at this central office answers the call by establishing a battery and ground connection for the operation of relay 703, which is bridged across the tip and ring conductor of trunk 700. Relay 703 in operating closes an obvious circuit for the operation of relay 702. Relay 702 extends the tip and ring connections from the operator at the distant end to the calling subscriber in this exchange. The supervisory relay 705 is thereby operated to maintain relay 701 operated. Relay 701 is slow in releasing so that it will be maintained operated after the release of relay 703 and operation of relay 702, until the operation of relay 705. Relay 701 maintains relay 702 operated over a holding circuit for this latter relay through the upper outer armature and front contact thereof. When the connection is released relay 705 is released causing the release of all the relays in this circuit.

It should be noted that the circuit arrangements shown for extending a connection to a central office are such that in case the calling subscriber is not permitted to call at a cen-

tral office a busy tone will be transmitted to such a subscriber if he attempts to call. The line of the subscriber at A is arranged for such restricted service. As hereinbefore described relay 307 operates when the subscriber at A calls. When this subscriber attempts to make the above described connection to a central office by dialing the number 6, relay 325 will not be operated but the connection over lead 327 will in this case be extended to cause the operation of relay 419. A circuit will be extended from battery, through the winding of this relay, make-before-break contact of relay 426, make-before-break contact of relay 419, lead 328, upper armature and front contact of relay 307, to ground at the sixth terminal of the commutator 506, over brush 415 and as hereinbefore described to the ground at relay 411. Relay 419 in operating connects a busy tone from the source 427 to be applied to the ring conductor of the trunk 207 thus notifying the calling subscriber of this particular service condition.

What is claimed is:

1. In a telephone system, subscribers' lines, trunks, automatic switches associated with said subscribers' lines, hunting switches associated with said trunks, and means for actuating an automatic switch in one manner to cause it to release and thereafter reactuate to connect a calling subscriber's line with a called subscriber's line and for actuating it in another manner to cause the hunting switch of an idle trunk to connect said trunk with the calling subscriber's line.
2. In a telephone system, calling lines, called lines, trunks, automatic switches associated with said subscribers' lines, hunting switches associated with said trunks, means for actuating an automatic switch in one manner to cause it to release and thereafter reactuate to extend the associated calling line to a called line, and means for actuating said automatic switch in another manner to cause the hunting switch of an idle trunk to connect said trunk with said calling line and to cause said automatic switch to be disassociated from the calling line and released.
3. In a telephone system, calling lines, called lines, trunks, automatic switches associated with said lines, hunting switches associated with said trunks, means responsive to certain series of impulses received over a calling line for actuating the associated automatic switch in one manner to cause it to release and thereafter reactuate to connect said calling line with a desired called line, and means responsive to certain other series of impulses received over said calling line for actuating said automatic switch in another manner to cause the hunting switch of an idle trunk to connect said trunk with the calling line and to cause said automatic switch to be disassociated from said calling line and released.
4. In a telephone system, hunting switches.

a trunk for each switch, lines terminating in each switch, means for seizing a line, means for actuating the switch of any idle trunk to connect it to said seized line, and means for actuating any switch to connect its associated trunk with an idle line.

5 5. In a telephone system, hunting switches, a trunk for each switch, lines terminating in each switch, means for identifying any line at said switches, means for actuating the switch of an idle trunk for connecting said trunk to an identified line, and means for actuating any switch to connect its associated trunk with an idle line.

10 6. In a telephone system, hunting switches, a trunk for each switch, lines terminating in each switch, means for identifying any line at said switches, means responsive to the identification of a line for actuating the switch of an idle trunk to connect it to said line, means for seizing a trunk, and means responsive to the seizure of said trunk for connecting it with an idle line through the associated switch.

15 7. In a telephone system, subscribers' lines, trunks, automatic switches associated with said subscribers' lines, hunting switches associated with said trunks, means responsive to certain impulses from a subscriber's line for connecting said subscriber's line through the associated automatic switch to a desired subscriber's line, and responsive to certain other impulses for connecting said subscriber's line to an idle trunk through the associated hunting switch, means for seizing a trunk, means responsive to the seizure of a trunk for connecting it through the associated hunting switch to an idle automatic switch, and means thereafter responsive to impulses from said seized trunk for extending said last mentioned connection to a desired subscriber's line through said associated automatic switch.

20 8. In a telephone system, subscribers' lines, line finders having access to said subscribers' lines, automatic switches having access to said subscribers' lines, link circuits, each connecting a line finder with an automatic switch, hunting switches having access to said links, trunks, each terminating in a hunting switch, means for completing a connection from one subscriber's line to another through a line finder and its associated link and automatic switch, means for completing a connection from a subscriber's line to an idle trunk through a line finder, the associated link and the hunting switch associated with said idle trunk, and means for completing a connection from a trunk to a subscriber's line through the associated hunting switch, a link and its associated automatic switch.

25 9. In a telephone system, subscribers' lines, trunks divided into groups, automatic switches associated with said subscribers' lines, hunting switches associated with said

trunks, means for actuating an automatic switch in one manner to connect a calling subscriber's line with a called subscriber's line, and in another manner to mark a group of trunks and cause the hunting switch of an idle trunk in the marked group to connect said trunk to the calling subscriber's line.

10. In a telephone system, subscribers' lines, trunks, subscribers' line finders, a link circuit associated with each line finder, a connector associated with each link, a hunting switch associated with each trunk and having access to said links, means for extending a connection from a calling subscriber to a called subscriber including a line finder and its associated link and connector, means for extending a connection from a calling subscriber to an idle trunk including a line finder and its associated link and a hunting switch, and means whereby the associated connector is employed as a marking switch during the establishing of the last mentioned connection to start the hunting switch of an idle trunk to connect it to the link circuit and without reserving for marking any of the connecting terminals of the connector.

11. In a telephone system, groups of lines, a group of automatic switches associated with said lines and having access to a certain group of lines, other groups of automatic switches, each group having access to a certain group of other lines, a hunting switch associated with each automatic switch in said other groups of automatic switches, said hunting switches having access to all of the lines in all of said groups, means for actuating any one of said first mentioned automatic switches to connect the associated line with any line to which said automatic switch has access, and means for actuating any one of said first mentioned automatic switches in a different manner to cause an idle hunting switch to connect the automatic switch associated therewith to the line associated with the actuated first mentioned automatic switch.

12. In a telephone system, groups of lines, a group of automatic switches associated with said lines and having access to a certain group of lines, other groups of automatic switches, each group having access to a certain group of other lines, a hunting switch associated with each automatic switch in said other groups of automatic switches, said hunting switches having access to all of the lines in all of said groups, means for actuating any one of said first mentioned automatic switches to connect the associated line with any line to which said automatic switch has access, and means for actuating any one of said first mentioned automatic switches in a different manner to cause an idle hunting switch to connect the automatic switch associated therewith to the line associated with the actuated first mentioned automatic switch, and means for actuating the automatic switch associated

with the seized hunting switch to connect the line connected through said hunting switch with any line in the group to which said automatic switch has access.

5 In witness whereof, I hereunto subscribe my name this 31st day of October, 1928.

EDWARD E. HINRICHSSEN.

10

15

20

25

30

35

40

45

50

55

60

65