Nov. 3, 1942. J. W. GOODERHAM 2,300,829

CALLING LINE IDENTIFICATION SYSTEM

Filed March 22, 1940 14 Sheets-Sheet 2

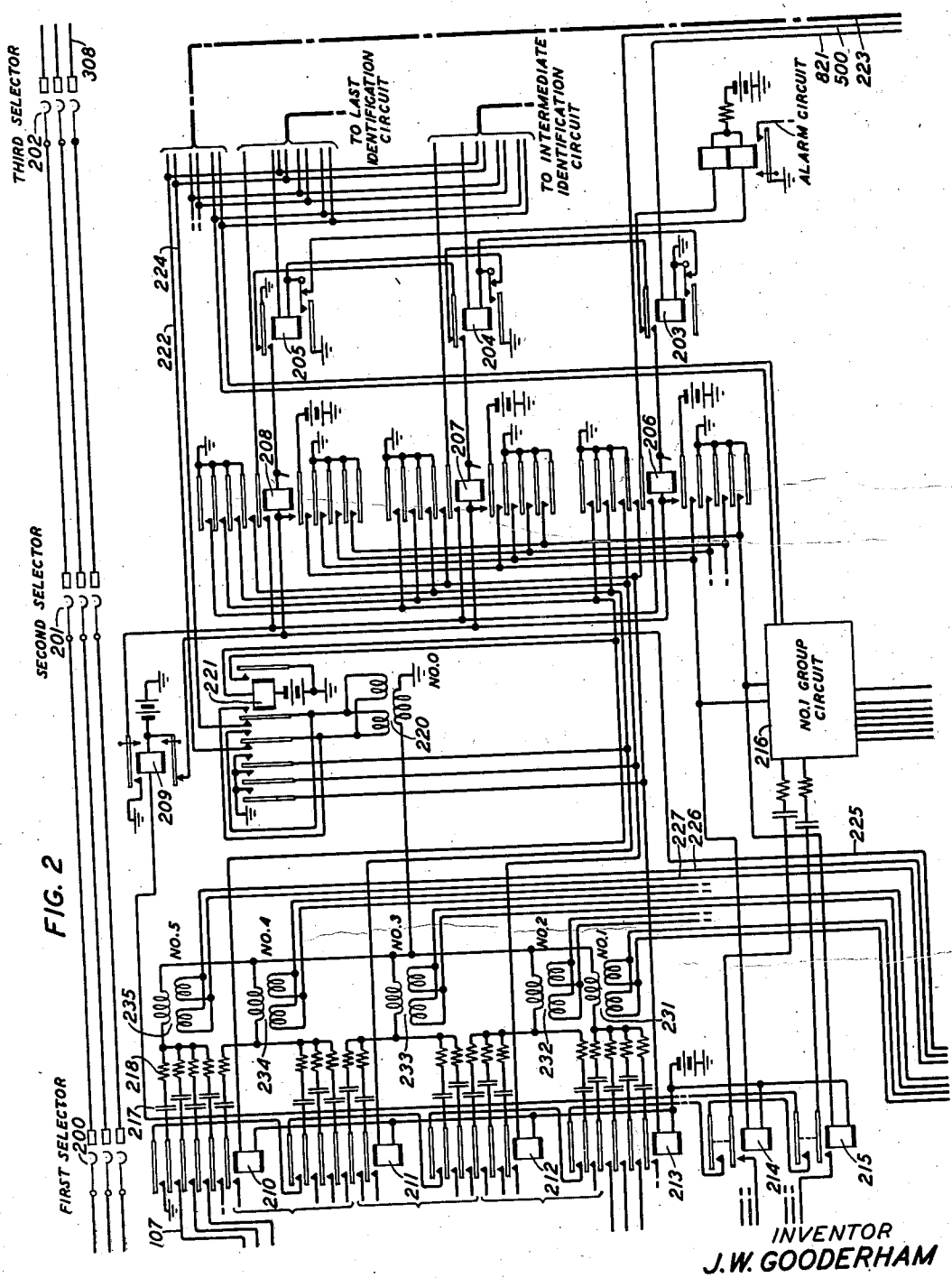

FIG. 2

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CALLING LINE IDENTIFICATION SYSTEM

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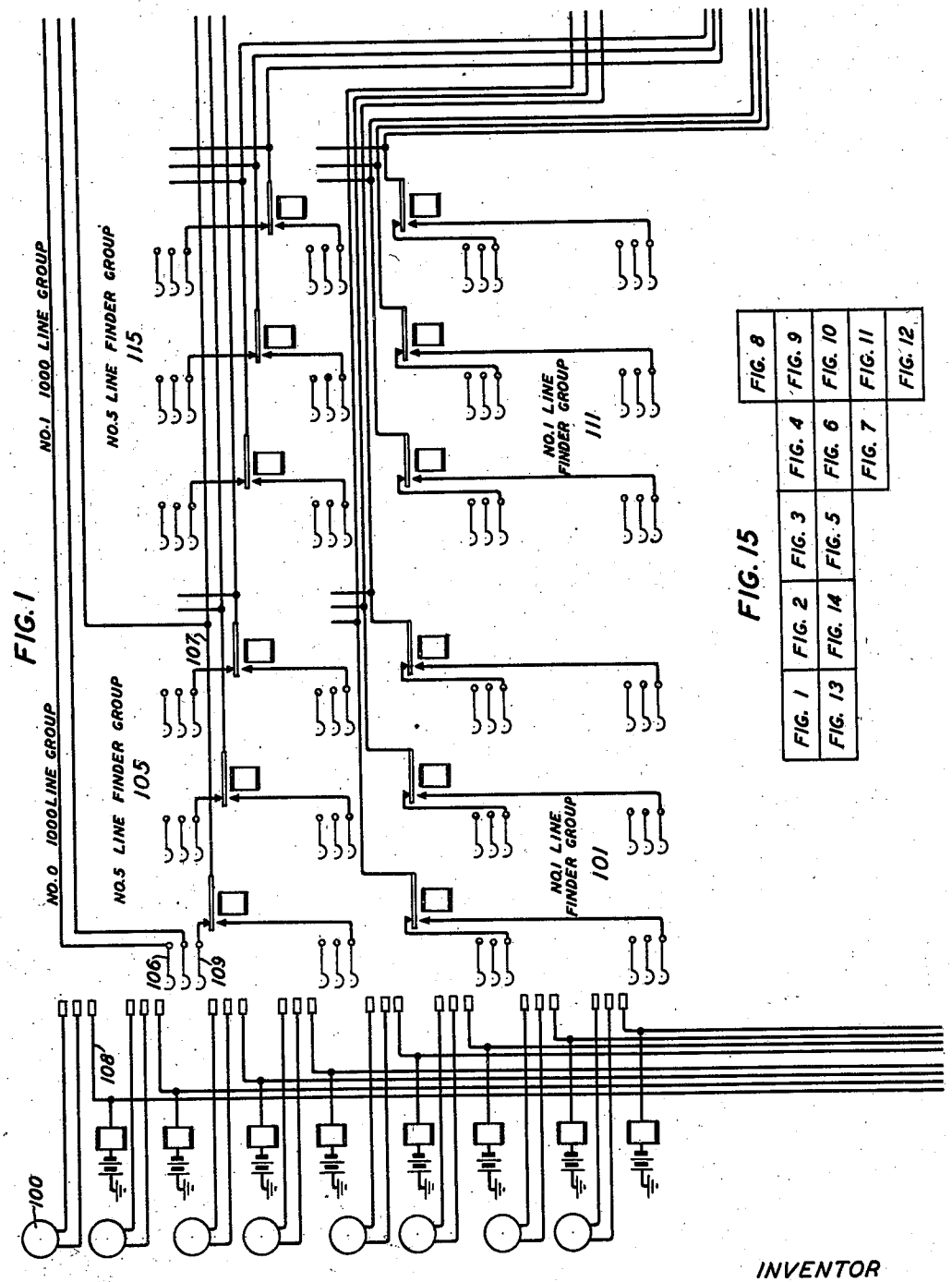

FIG. 1

FIG. 15

FIG. 8	FIG. 9	FIG. 10	FIG. 11	FIG. 12
FIG. 4	FIG. 6	FIG. 7		
FIG. 3	FIG. 5			
FIG. 2	FIG. 14			
FIG. 1	FIG. 13			

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CALLING LINE IDENTIFICATION SYSTEM

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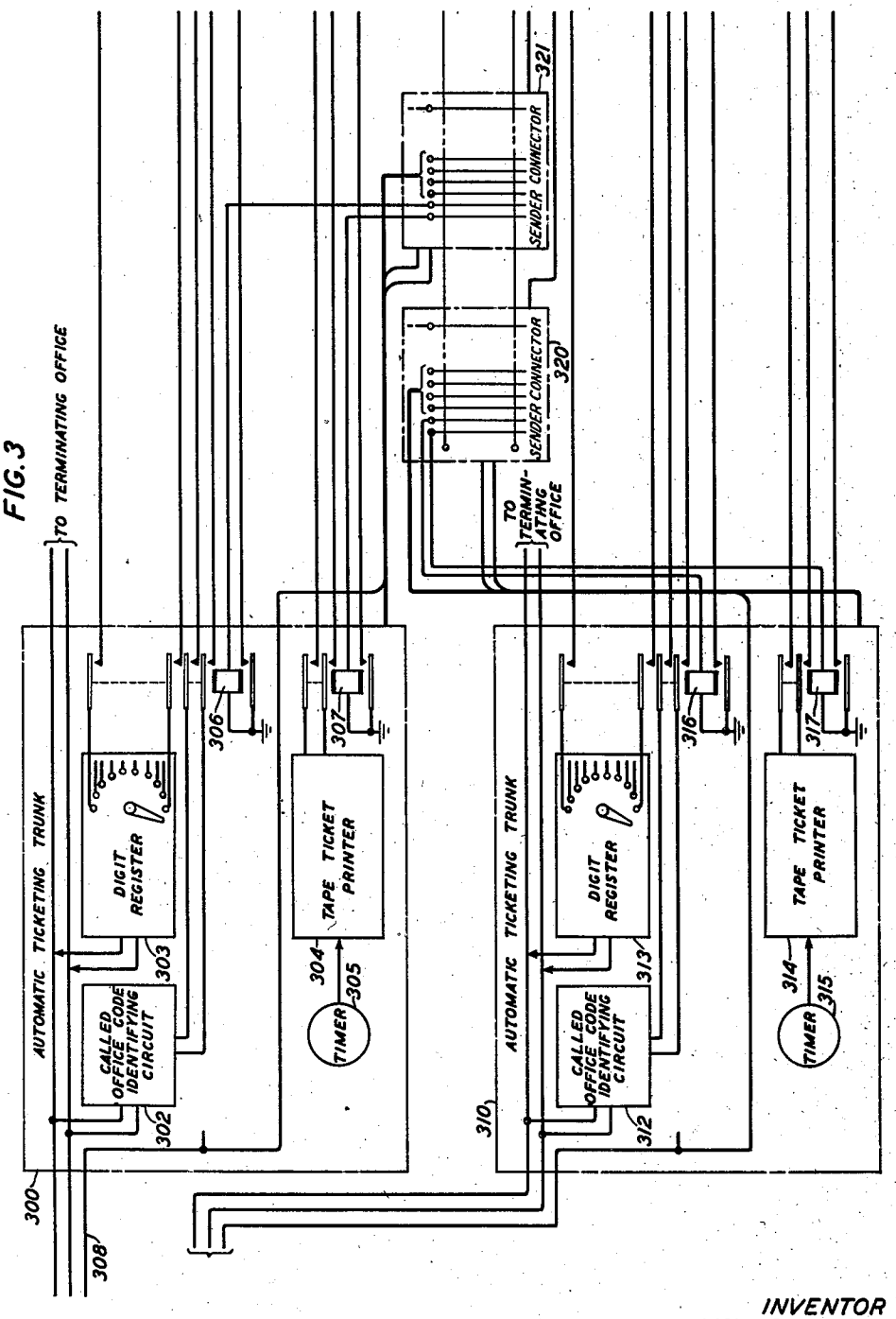
FIG. 3



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CALLING LINE IDENTIFICATION SYSTEM

Filed March 22, 1940 14 Sheets-Sheet 4

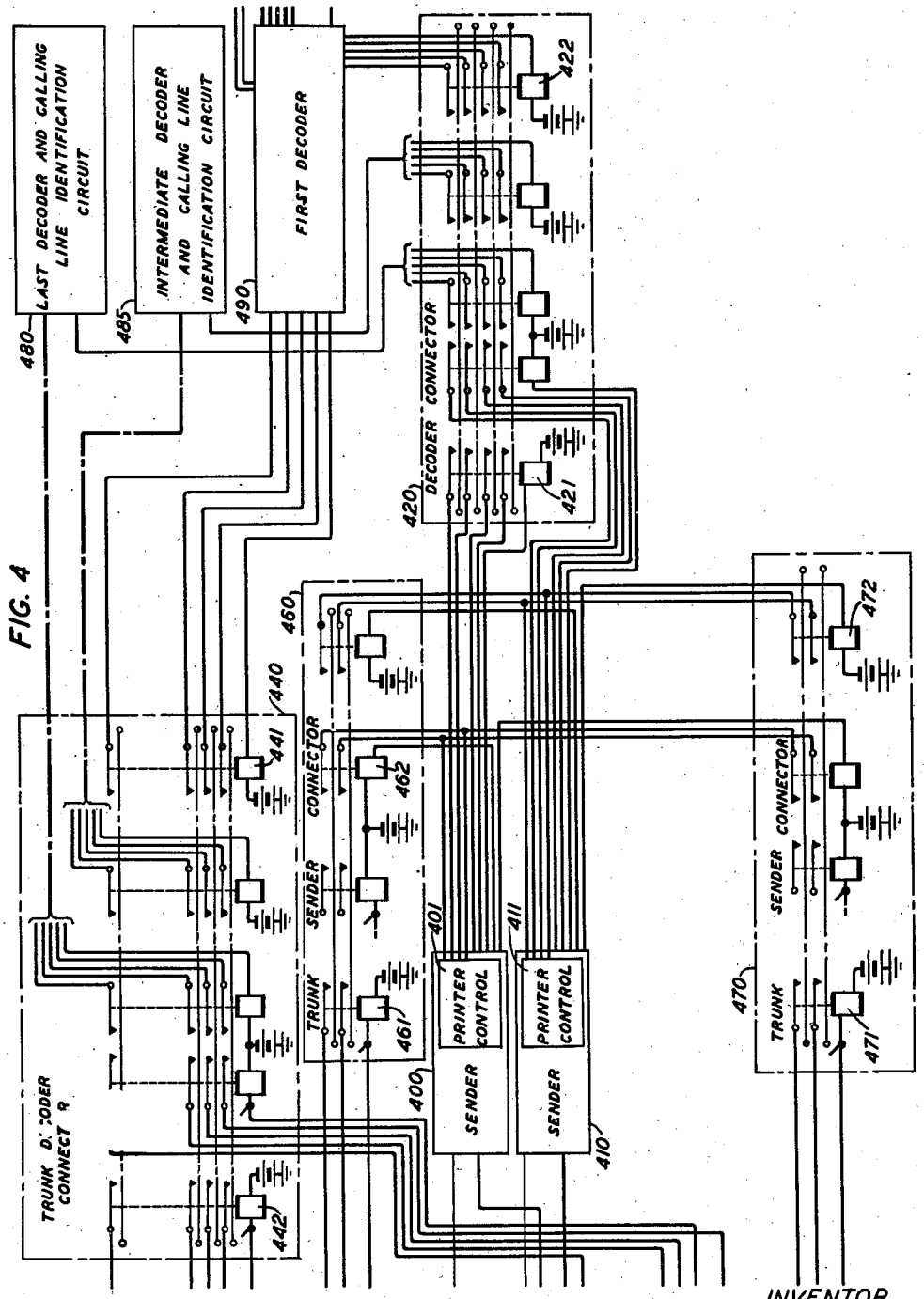

FIG. 4

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CALLING LINE IDENTIFICATION SYSTEM

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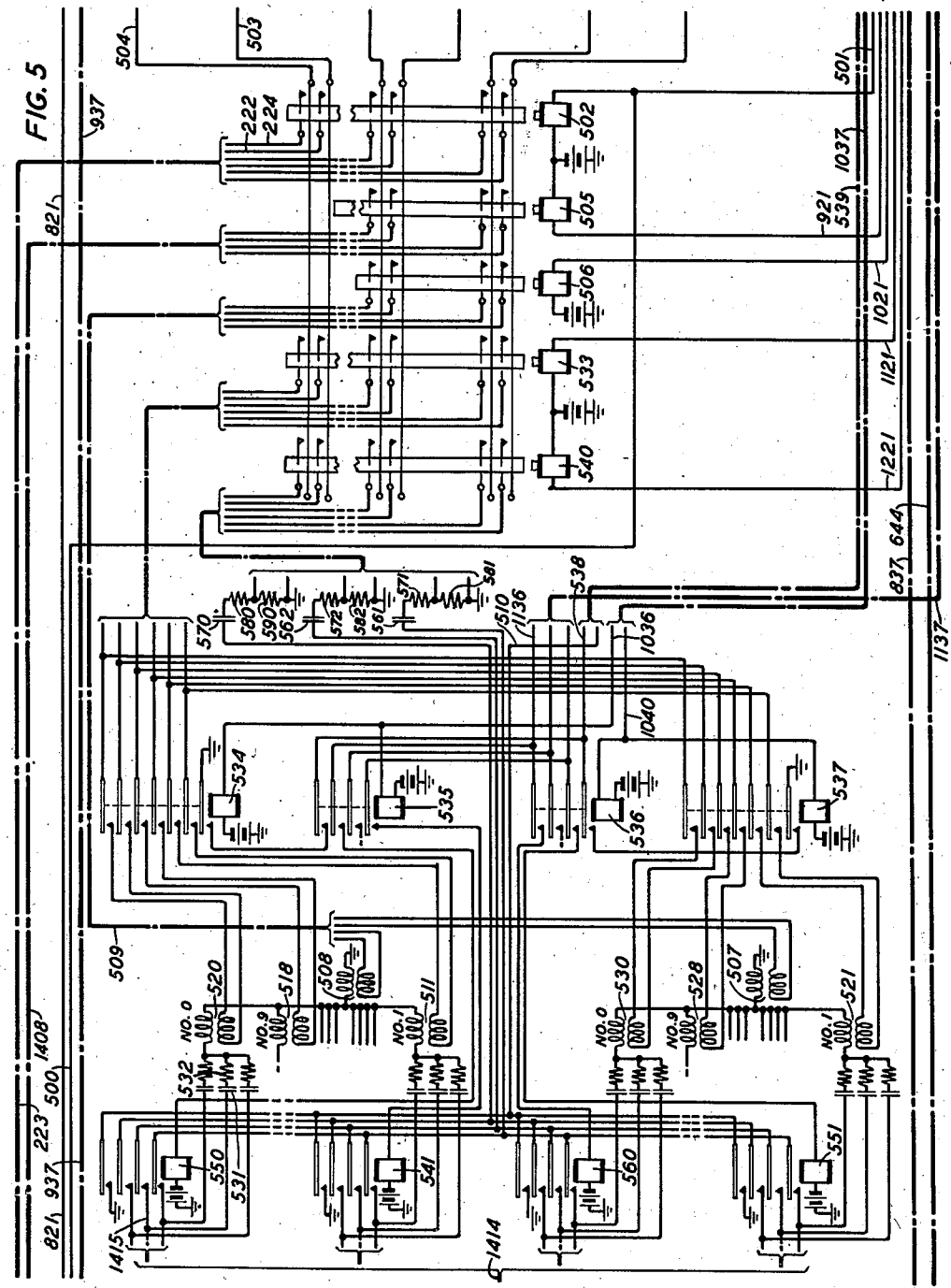
FIG. 5



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CALLING LINE IDENTIFICATION SYSTEM

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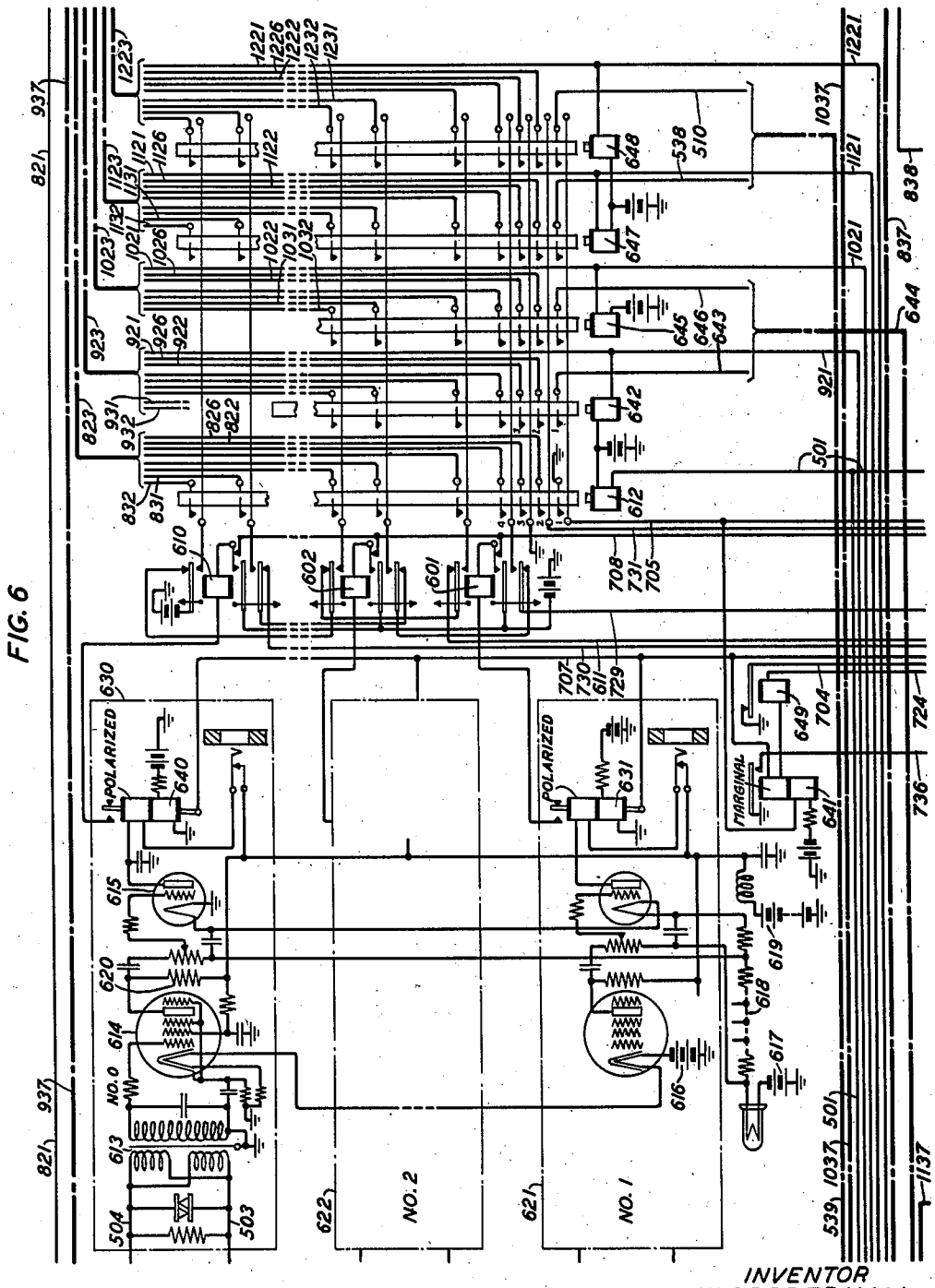

FIG. 6

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CALLING LINE IDENTIFICATION SYSTEM

Filed March 22, 1940 14 Sheets-Sheet 7

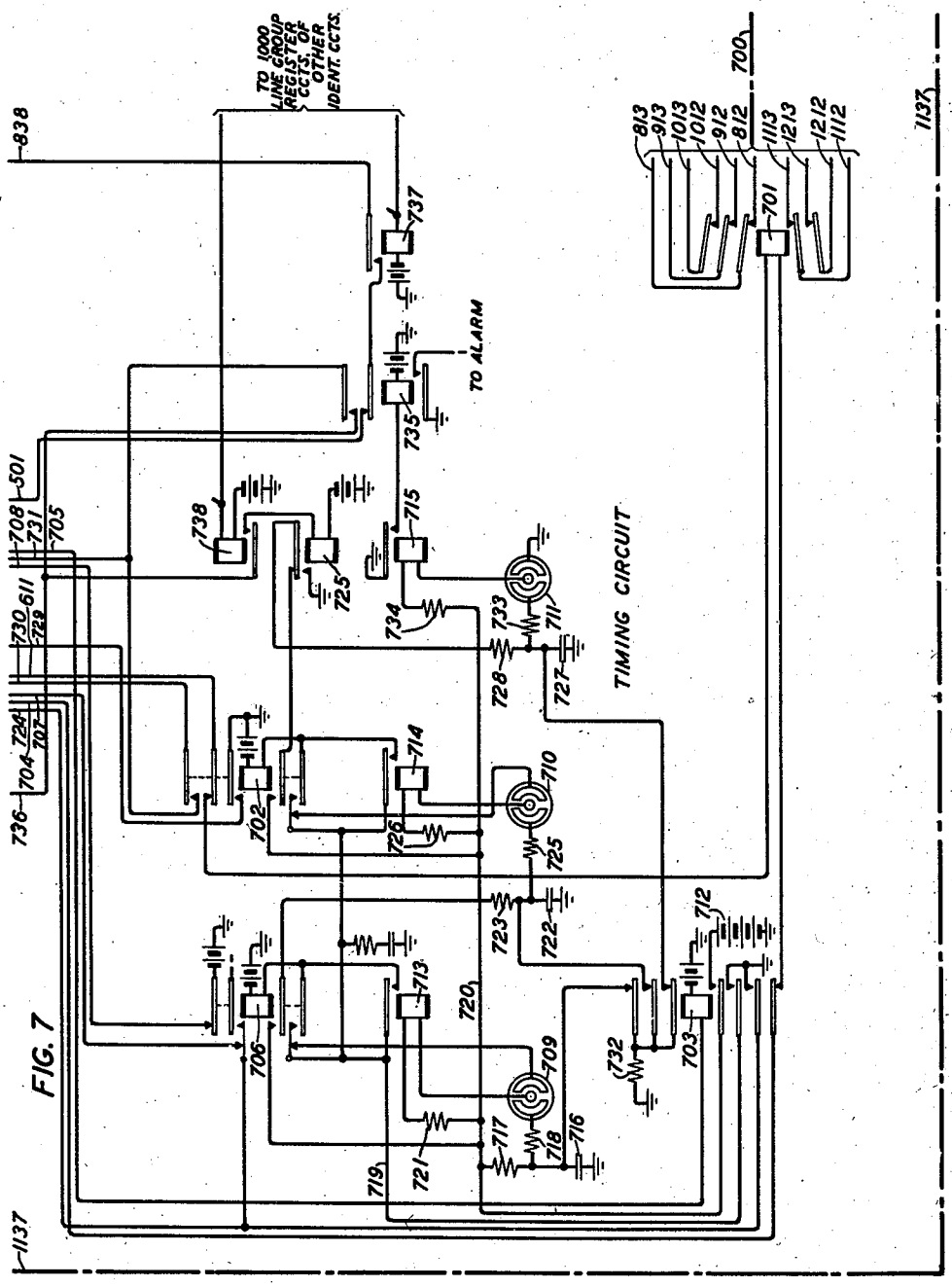

FIG. 7

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CALLING LINE IDENTIFICATION SYSTEM

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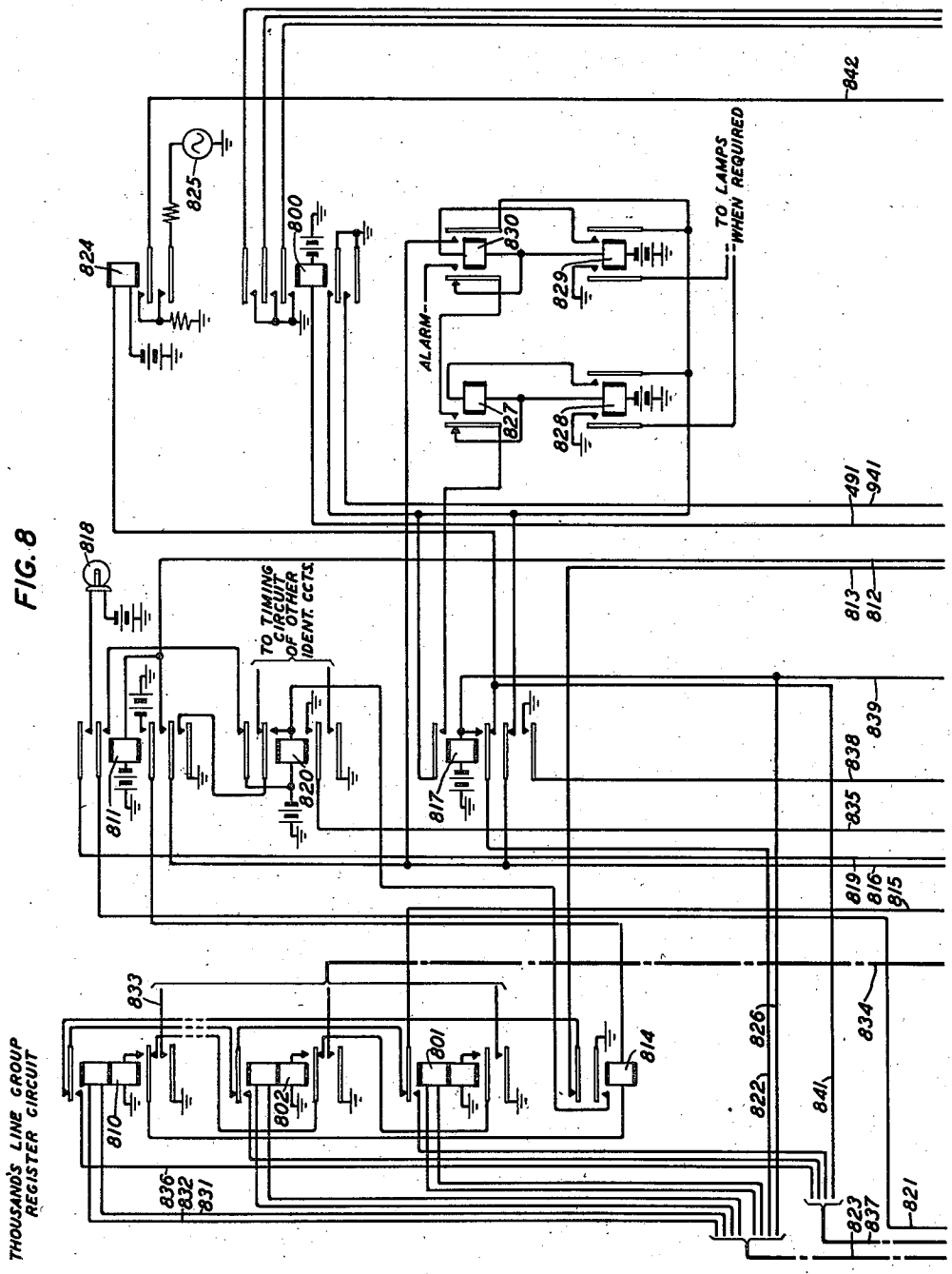

FIG. 8

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CALLING LINE IDENTIFICATION SYSTEM

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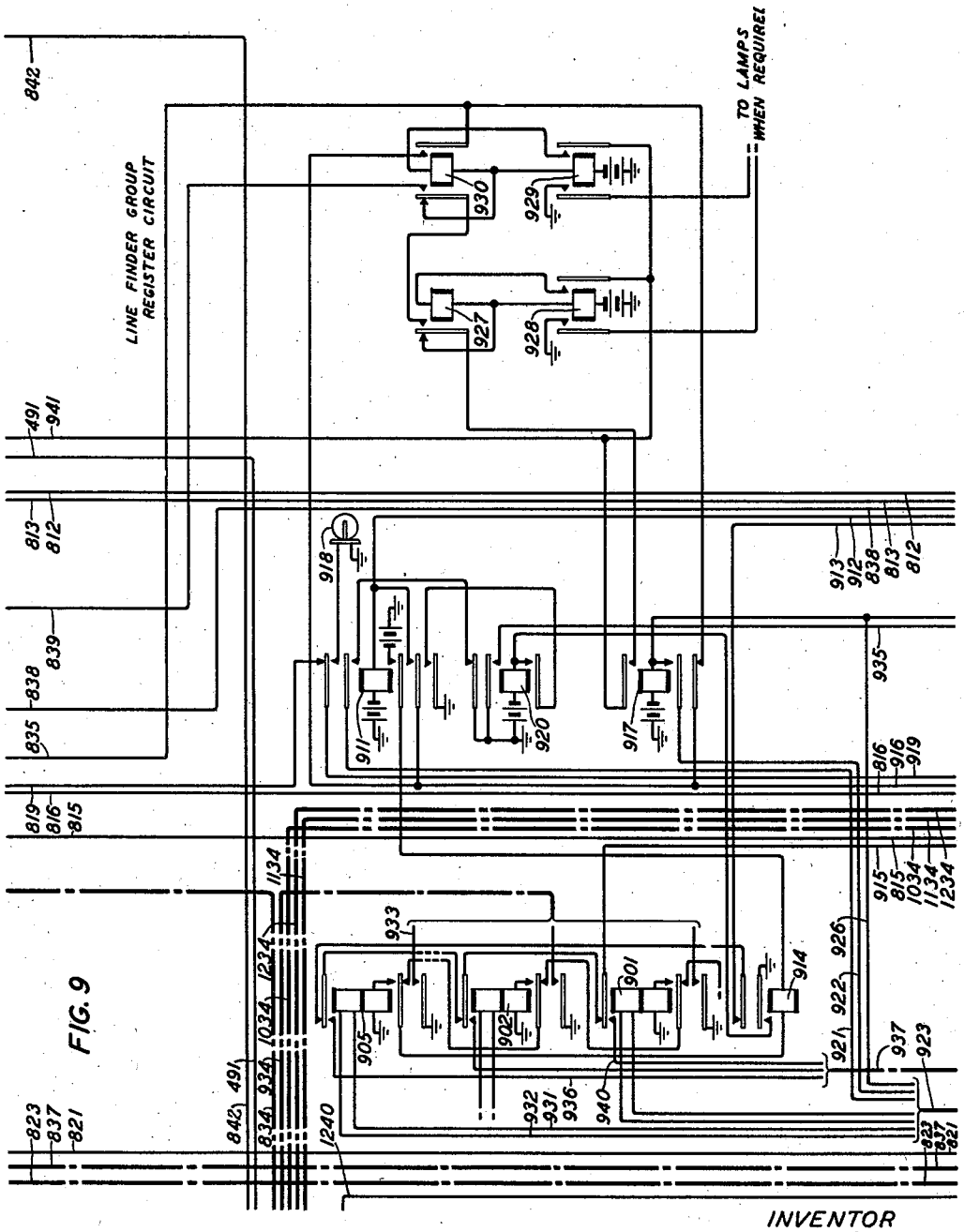

FIG. 9

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CALLING LINE IDENTIFICATION SYSTEM

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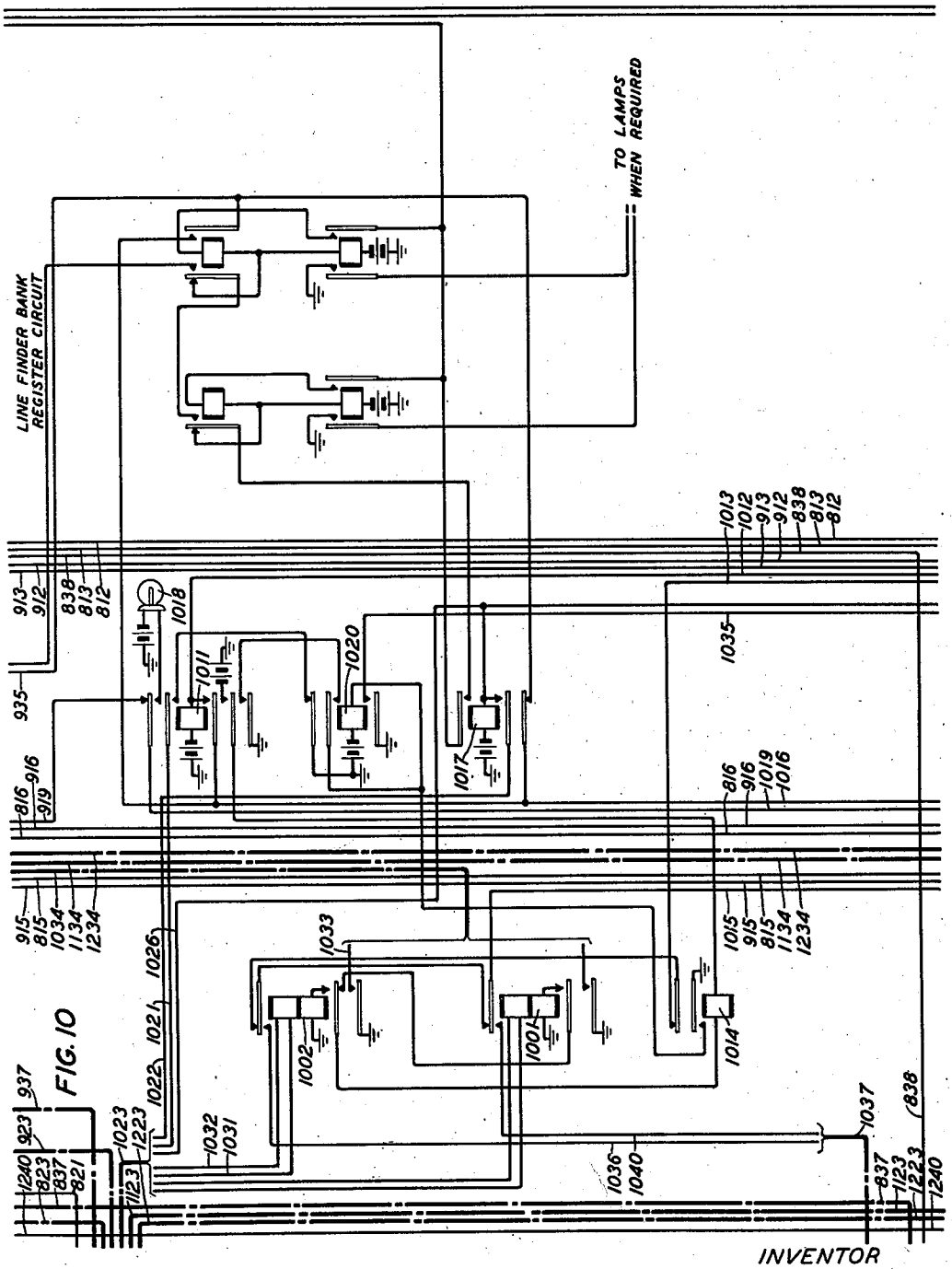

FIG. 10

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CALLING LINE IDENTIFICATION SYSTEM

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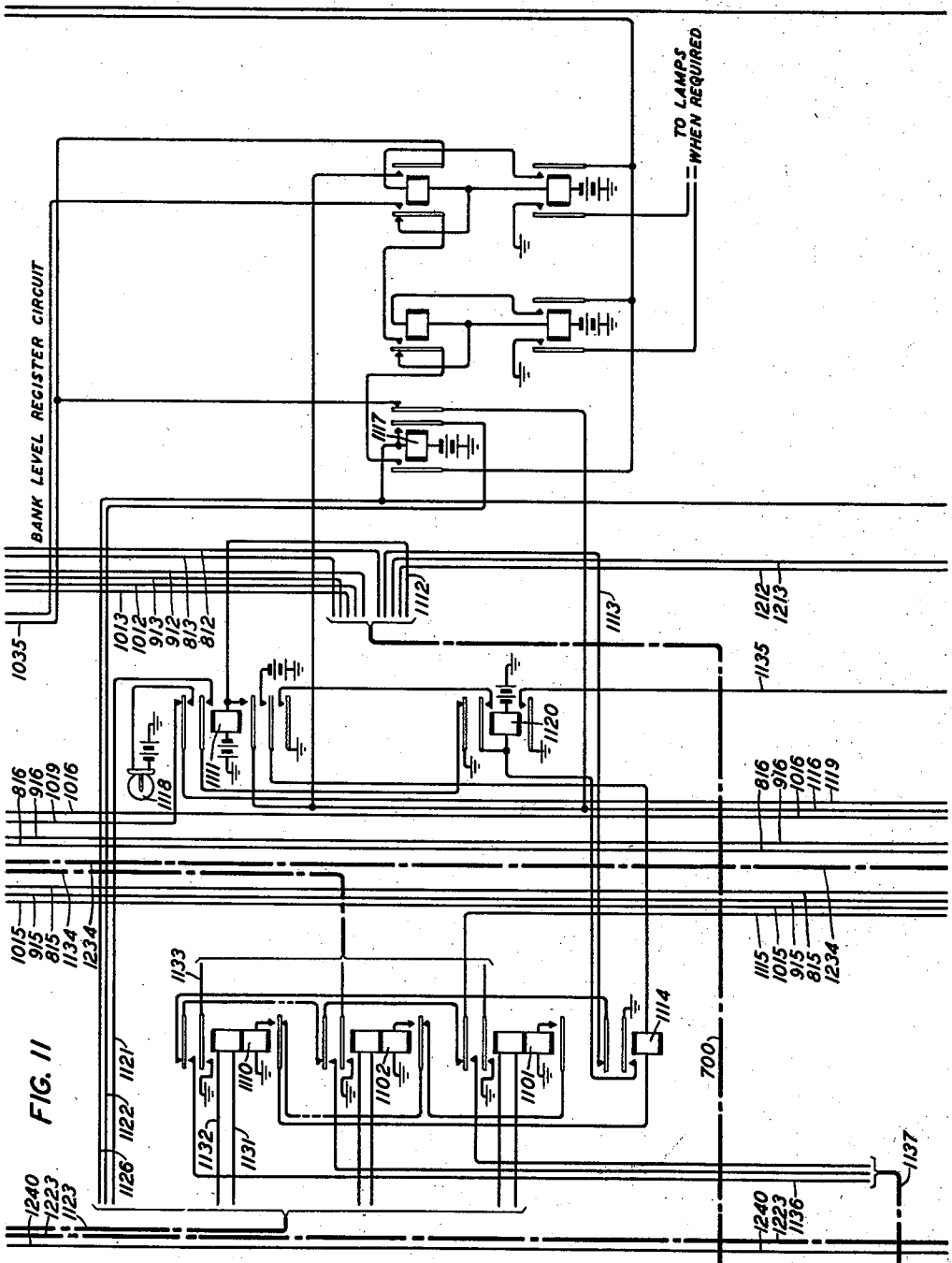

FIG. 11

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CALLING LINE IDENTIFICATION SYSTEM

Filed March 22, 1940 14 Sheets-Sheet 12

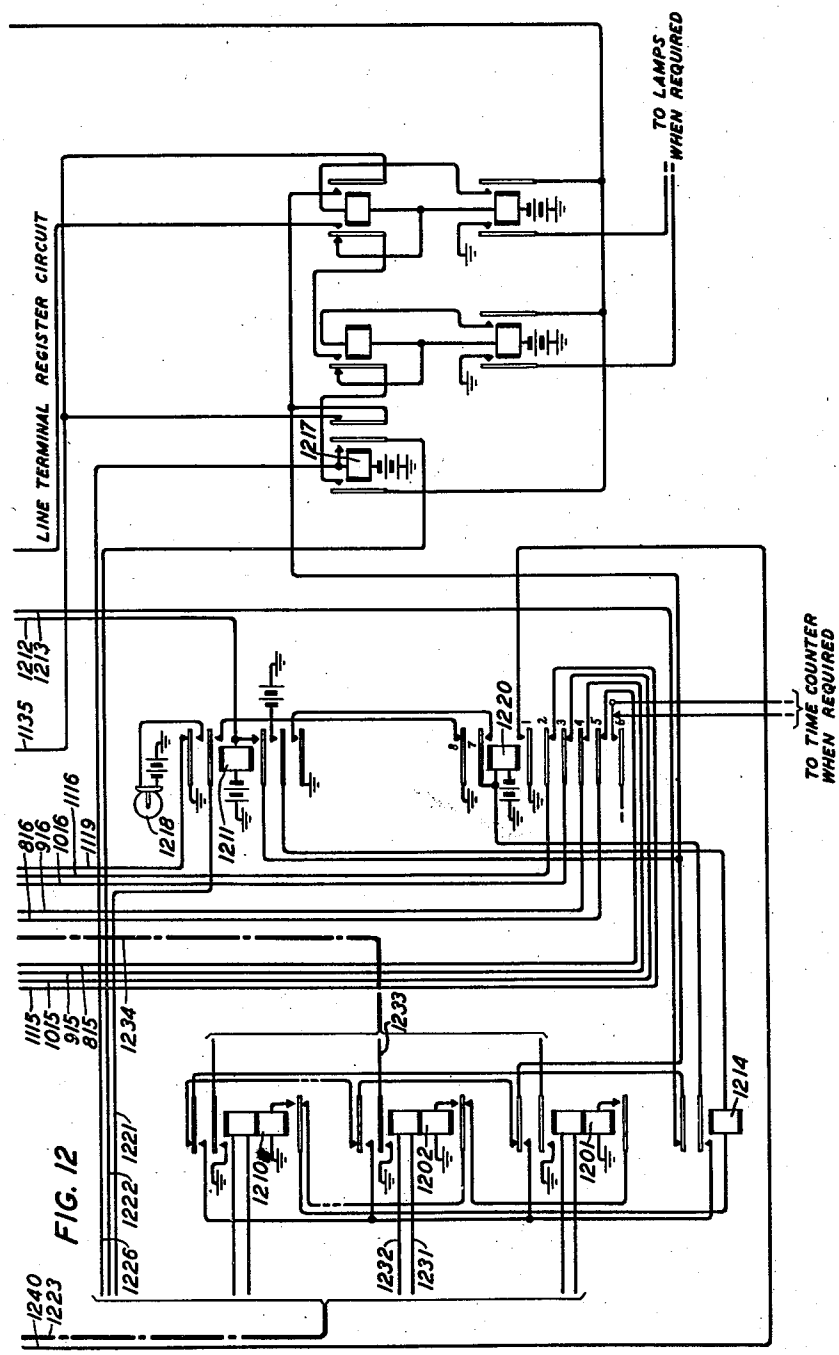

FIG. 12

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CALLING LINE IDENTIFICATION SYSTEM

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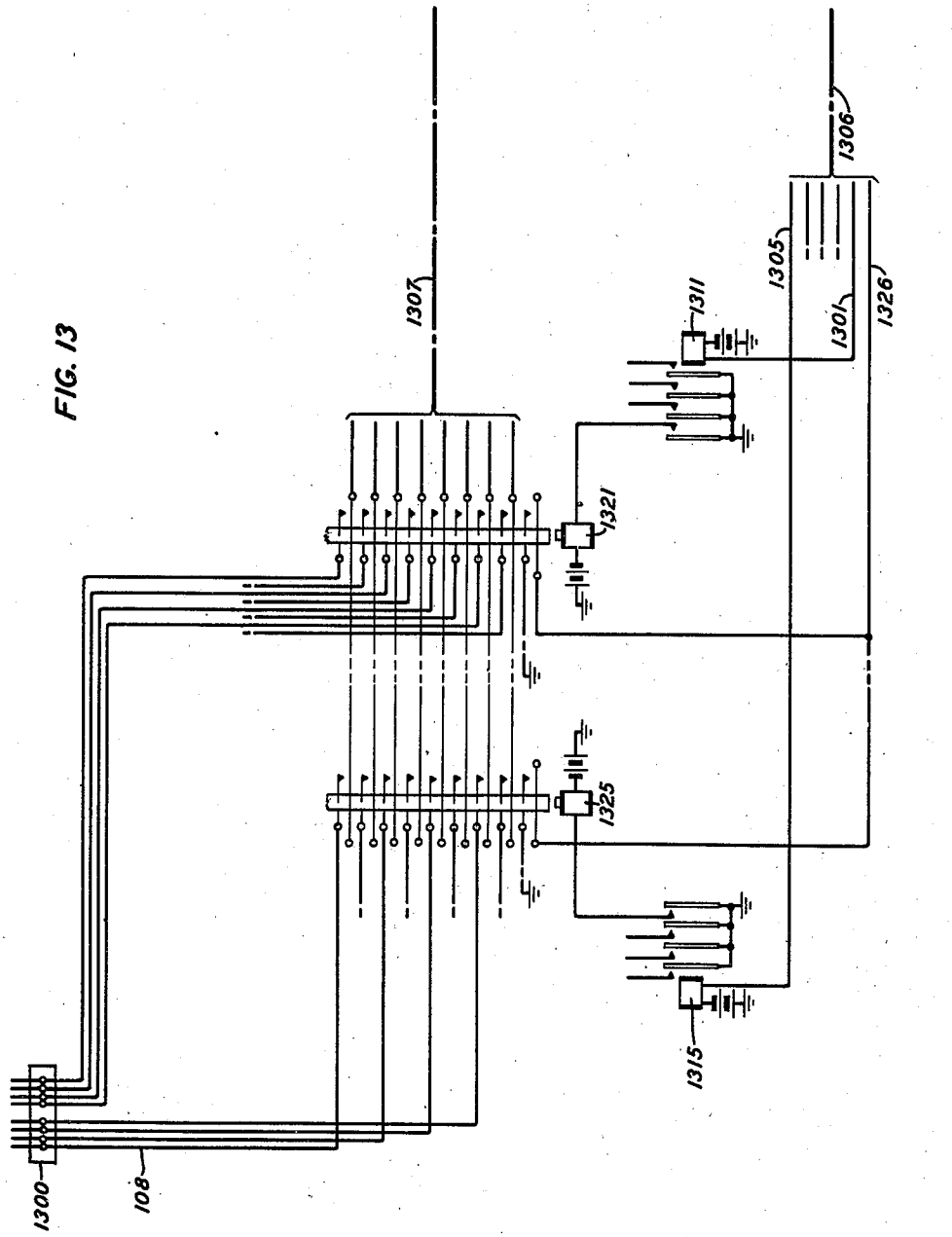
FIG. 13



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CALLING LINE IDENTIFICATION SYSTEM

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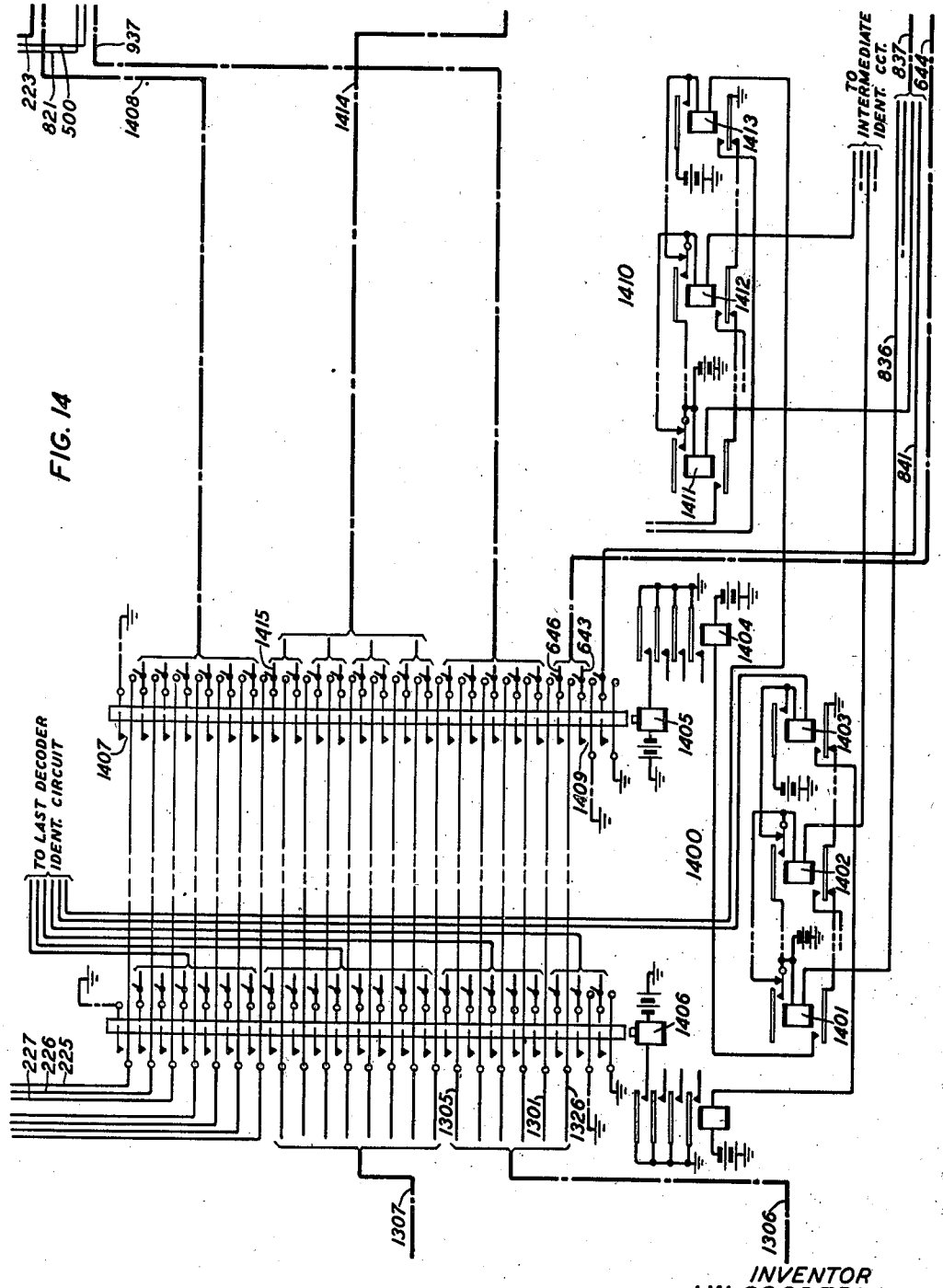

FIG. 14

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Patented Nov. 3, 1942 2,300,829

UNITED STATES PATENT OFFICE

2,300,829

CALLING LINE IDENTIFICATION SYSTEM

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Application March 22, 1940, Serial No. 325,342

21 Claims. (Cl. 179—7.1)

This invention relates to a telephone system and more particularly to a system in which it is desirable to register in equipment common to a plurality of subscribers' lines the identity of any one of the lines which may have originated a call.

In the establishment of toll calls in systems equipped with automatic switching mechanisms, it is the usual procedure to permit subscribers to obtain access to a toll operator's position by dialing the digit zero or a suitable code of digits. The toll operator upon answering a call for toll service then secures from the calling subscriber the necessary information for completing the connection and the number of the calling subscriber's line and then proceeds to complete the connection. Since it is necessary to charge a subscriber for each toll call made during a billing period, the toll operator makes out a toll ticket for each completed call, which ticket has thereon the calling subscriber's line number, the number of the line called, the time when the called subscriber answered and the time when the conversation ended. These tickets are then used by the commercial department of the operating company in making out the regular bill for telephone service, the charges for toll calls made by any subscriber during the billing period being computed from the tickets representing the toll calls and added to the amount to be charged such subscriber for local service connections.

In order that toll calls may not erroneously be charged to subscribers who have not made such calls, the calling line number given to the toll operator is customarily checked by the toll operator by the application of tone current over the connection established from the line to the operator's position to a conductor associated with the calling line and by detecting the tone current through the connection of her headset receiver to a number checking multiple of the calling line connected to that conductor. If the subscriber has given his line number correctly to the operator, the tone current will be detected by the operator and the operator may then make out the toll ticket accordingly.

It has heretofore been proposed to display the number of a calling subscriber's line on a suitable lamp board located at or visible from the toll operator's position thereby obviating the necessity for the calling subscriber to orally inform the operator as to the identity of his line. It has also been proposed to eliminate the services of a toll operator on calls to toll points which are not too remotely removed from the dial switching exchange area by providing facilities for automatically printing on a toll ticket all of the information which may be required for billing purposes, that is, the calling and called subscribers' line identifications, the elapsed time of the conversation, etc.

It is the object of the present invention to provide calling line identification circuits which are enabled to record the identification of any calling line of an office in a simple and inexpensive manner whereby such line identification record may be used either by a toll operator or by automatic ticketing equipment in the production of a toll ticket for any toll call made by a subscriber.

As illustrative of the manner in which this object may be attained, the present invention has been disclosed in connection with a system in which all short haul toll connections to nearby toll points may be established by automatic switching equipment in response to the dialing of called line numbers by a calling subscriber and in which toll tickets for such calls are automatically printed or otherwise made, but it is to be understood that the invention is equally applicable to systems in which all toll connections are established through the services of a toll operator and for which the toll operator makes out toll tickets in the usual manner. The invention has been illustrated in connection with telephone systems employing step-by-step type switches but switches of other well-known types could equally well be employed. As illustrated, a subscriber, desiring a connection to a line terminating in an office in the nearby toll area, first removes his receiver from the switchhook whereby an idle line finder paired with a first selector is started in search of the calling line and as soon as the line is found, the usual dial tone is transmitted. Upon hearing the dial tone the subscriber then proceeds to dial the office code and numerical digits of the wanted line number. In response to the dialing of one or more of the office code digits, the selector switches of a switching train including the first selector switch are operated to extend a connection from the calling line to an idle automatic ticketing trunk, accessible from all lines of the office in which the calling line terminates, over which trunk a connection may be further extended to the office in which the wanted line terminates.

Immediately following the seizure of the trunk, an idle sender common to a plurality of ticketing trunks is associated with the seized trunk over a sender-connector of the cross-bar or step-by-step type. The sender is provided with reg-

isters for registering the remaining digits of a called line number dialed by the calling subscriber. Since, however, a digit dialed by a calling subscriber might be lost during the time elapsing from the seizure of the trunk and before the idle sender becomes connected with the trunk, the trunk is provided with a digit register for registering the digit dialed following the last code digit dialed to reach the trunk. Since the trunk may be seized in response to the dialing of one, two or three code digits, this register may register either the second or third code digit or the thousands numerical digit. As soon as the first digit has been registered in the sender, which digit may be either the third code digit, the thousands digit or the hundreds digit, an idle decoder is associated with the sender over a decoder-connector and the decoder is associated directly with the trunk over a trunk decoder-connector. Thereupon office code identifying equipment associated with the trunk transfers to registers in the decoder information regarding the office code digits dialed to reach the trunk and if office code digits have been registered by the trunk register or by the first register of the sender, such registration or registrations are also transferred to the decoder whereby the decoder thus receives all of the information necessary regarding the office designation of the desired line. This information is then transferred to control registers of the sender which are instrumental in controlling selector switches to extend the connection from the trunk to the office in which the wanted line terminates and in controlling a ticket printer individual to the trunk to print the called office code digits on a toll ticket. The sender also registers the remaining numerical digits dialed by the calling subscriber and in accordance with such registrations directs the setting of selector switches in the called office to complete the connection, such numerical digit registrations also being effective to control the printer to print such numerical digits on the toll ticket. For controlling the ticket printer in accordance with the code and numerical digit registrations made in the sender, the sender becomes associated with the trunk over a trunk sender-connector.

Since the trunk circuit, the called office code digit identifying equipment of the trunk circuit and of the decoder and the switching mechanism for associating the sender with the trunk and for associating the decoder with the sender and with the trunk enter only incidentally into the disclosure of the discussion of the present invention, they have been disclosed schematically herein. For a more detailed disclosure thereof, reference may be had to the copending application of A. J. Busch, Serial No. 325,304, filed March 22, 1940.

Associated with each decoder and preferably forming an integral part thereof is a calling line identification circuit comprising a plurality of register circuits for registering the several elements of the line identification of any calling line in the office. The identification circuits of all decoders have common access to an identification circuit which has access to the sleeve conductors of all line finders and to the sleeve conductors of all lines of the office. To identify a calling line, the decoder upon its seizure applies an alternating current signal to the sleeve of the ticketing trunk which is transmitted back over the sleeve circuit established to the trunk from the calling line. The line-finder sleeves are grouped first with respect to all the line finders serving each group of two hundred lines and secondly with respect to groups of five such line-finder groups to form ten master groups each serving one thousand lines. Thus the decoder identification circuit first determines the master group of one thousand lines and makes a registration thereof and then determines the line-finder group of two hundred lines and makes a registration thereof by detecting the tone current applied to the sleeve conductor of the line finder employed in establishing a connection. The remaining stages of identification employ the calling line sleeve conductors by first determining whether the calling line terminates in the upper or lower bank of a line finder of the detected two hundred line group and making a registration thereof, by then determining the level of the bank in which the line terminates and making a registration thereof, and finally by determining the particular terminal of the level in which the line terminates and making a registration thereof by detecting the presence of the tone current on the sleeve conductor of the calling line. These five registrations thus identify the calling line on a line-finder terminal basis and may be employed to light lamps to display the calling line identification or as disclosed such registrations may be transferred to registers in the printer control circuit of the sender for controlling the ticket printer of the ticketing trunk to print the digits on the toll ticket.

The ticket printer may also be controlled following the response of the called subscriber and during the continuance of the conversation to print information on the toll ticket indicative of the duration of the conversational period.

The invention having been described in a general manner, reference may now be had to the following detailed description thereof taken in connection with the accompanying drawings in which:

Fig. 1 shows schematically a plurality of line finders, grouped first in master groups each serving one thousand lines and then into subgroups each serving two hundred lines and a plurality of lines terminating in different banks and bank levels of line finders of the subgroups of one of the master groups;

Fig. 2 schematically discloses in the upper portion thereof a train of selector switches over which a connection may be established from certain of the calling lines over a line finder having access thereto to a toll ticketing trunk such as is disclosed in Fig. 3 and in the lower portion thereof a part of the one thousand line group circuits of the calling line identification circuit which are instrumental in determining the master group of one thousand lines and the two hundred line subgroup thereof in which a calling line is located;

Fig. 3 shows schematically two automatic ticketing trunks belonging to different groups of such trunks and connector switches of the crossbar type by which a calling one of such trunks may be associated with an idle sender;

Fig. 4 shows schematically two senders to which all ticketing trunks have common access, trunk sender-connectors by means of which the printer control equipment of any sender seized by any trunk may be associated with the tape ticket printer of the trunk, a plurality of decoders, a decoder-connector for associating an idle one of said decoders with the sender taken into use by any trunk and a trunk decoder-con-

nector for associating the seized decoder directly with the calling trunk for enabling the decoder to receive from the trunk information relative to the called office code digits dialed by a subscriber;

Fig. 5 discloses in the left portion thereof the bank and level determining portion of the calling line identification circuit which is instrumental in determining the line-finder bank, the bank level and the terminal of the level in which any line terminates and in the right portion thereof switching relays for successively rendering different portions of the circuits of Figs. 2 and 5 effective;

Fig. 6 discloses in the right portion thereof other switching relays and in the left portion thereof groups of amplifier and detector tubes connectable to the several portions of the identifying circuit through the operation of the switching relays of Fig. 5 for detecting the presence of tone current on the line-finder sleeve conductor and line sleeve conductor of any connection established by a calling line and register relays associable with the detector tubes;

Fig. 7 discloses a timing circuit associated with the circuits of Fig. 6;

Fig. 8 discloses a register circuit for registering the particular one thousand line group in which any calling line is located;

Fig. 9 discloses a register circuit for registering the particular line-finder group in which a calling line is located;

Fig. 10 shows a register circuit for registering the line-finder bank in which a calling line terminates;

Fig. 11 shows a register circuit for registering the line-finder bank level in which a calling line terminates;

Fig. 12 shows a register circuit for registering the terminal of the line-finder bank level in which a calling line terminates;

Fig. 13 shows multicontact relays for connecting the sleeve conductors of groups of two hundred lines through the contacts of multicontact relays of the thousands line group connector circuit of Fig. 14 to the amplifier-detector circuits, to the bank and level determining circuits of Fig. 5 and to the line-finder group register circuit of Fig. 9;

Fig. 14 shows multicontact relays of the thousands group connector circuit; and,

Fig. 15 is a diagram indicating how the other figures of the drawings should be arranged to completely disclose the invention.

The line finders schematically illustrated in Fig. 1 are of the well-known step-by-step type each having two brush sets one of which has access to an upper bank of terminals in which one hundred lines terminate and the other of which has access to a lower bank of terminals in which a second one hundred lines terminate. Each group of two hundred lines is accessible from a subgroup of line finders, an idle one of which is started upon the initiation of a call from any line of the group. The five subgroups of line finders serving a master group of one thousand lines are grouped together, two of the subgroups of line finders serving the No. 1 and No. 5 two hundred line subgroups of the No. 0 thousands master group of lines being indicated by numerals **101** and **105** and two of the subgroups of line finders serving the No. 1 and No. 5 two hundred line subgroups of the No. 1 thousands master group of lines being indicated by the numerals **111** and **115**. Other subgroups of line finders serving other subgroups of such master groups and subgroups of line finders serving the other eight master groups would be similarly provided.

To simplify the disclosure, the circuits of the line finders have not been disclosed in full and with the exception of line finder **106** only the sleeve conductors of the line finders, which are essential to the understanding of the invention, have been disclosed. The sleeve conductors of the subgroups of line finders of the No. 0 master group have branches which appear in contacts of multicontact relays of the thousands line group and line-finder subgroup determining circuits of Fig. 2. The sleeve conductors of the subgroups of other line finders of other master groups have branches which appear in contacts of relays of other thousands line group and line-finder subgroup circuits similar to that disclosed in Fig. 2. The sleeve conductors of all lines are connected over terminals on a terminal block **1300** to the contacts of groups of two hundred line connector relays of Fig. 13, four multicontact relays such as **1325** being provided for each two hundred line group of lines. By the interpolation of the connecting block **1300**, it is possible to terminate the line sleeve conductor of a line on the contact of one of these relays appertaining to a bank level and terminal position indicative of the tens and units digit of the line number regardless of whether that line actually terminates in that particular bank level and terminal position.

Each line finder is paired with a first selector switch **200** which has access to groups of trunks terminating in second selector switches such as **201** which in turn have access to groups of trunks terminating in third selector switches **202**. These switches may be of the well-known step-by-step type and may be controlled by a calling subscriber's dial to establish local connections or to establish a connection to an idle automatic ticketing trunk such as is disclosed at **300** in Fig. 3, should the subscriber desire a connection to a subscriber's line which terminates in the toll area adjacent to the exchange area in which the calling line terminates. As disclosed, the automatic ticketing trunk may be seized by a third selector in response to dialing the three office code digits of a wanted line, but it is to be understood that the same trunk may be seized from the banks of first or second selector switches in response to dialing the first or the first and second office code digits of lines terminating in other offices as fully set forth in the application of A. J. Busch hereinbefore referred to.

The cross-bar sender-connectors **320** and **321** of Fig. 3, the decoder-connector **420**, the trunk decoder-connector **440** and the trunk sender-connectors **460** and **470** of Fig. 4 may be of the same general type as are employed in the cross-bar system and as are disclosed, for example, in Patent 2,089,921, granted August 10, 1937, to W. W. Carpenter. The senders, two of which are schematically disclosed by boxes **400** and **410** of Fig. 4, may be of a well-known type provided with registering mechanism for registering digits of wanted line numbers dialed by calling subscribers and with pulsing mechanism for controlling the setting of selector switches in accordance with such registrations to extend a connection from a seized ticketing trunk to a wanted line. Each sender is also provided with a printer control circuit for controlling a ticket printer individual to the trunk with which a sender has become asso-

ciated to print on a toll ticket information with respect to the identity of the calling line and the identity of the called line. For assisting a sender in controlling the establishment of a desired connection, a plurality of decoders is provided, indicated by the boxes **480**, **485** and **490**, an idle one of which may become associated with a sender over the decoder-connector **420**. Each of these decoders has associated with it a calling line identification circuit, the identification circuit associated with decoder **490** being illustrated in detail in Figs. 5 to 12, inclusive. The calling line identification circuits disclosed in Figs. 2, 13 and 14 are individual to an exchange office of ten thousand lines and are common to all of the decoders.

To more clearly set forth the novel features of the invention, it will be assumed that the calling subscriber whose substation is indicated by the numeral **100** initiates a call for a toll connection to a subscriber's line terminating in an office in a toll area to which the calling subscriber is permitted access by dialing. Upon the removal of the receiver from the switchhook, an idle line finder having access to the two hundred line group in which the calling line is located is started in search of the calling line in the well-known manner. It will be assumed that the calling line is located in the No. 0 thousands line group of the office and may be reached by a line finder of the No. 5 line-finder group of the No. 0 thousands line group and that line finder **106** is started. It will also be assumed that the calling line terminates in the No. 2 terminal of the upper or No. 0 level of the upper bank of line finder **106**. When the line finder has found the calling line, the usual dial tone is transmitted to the calling subscriber's line to inform the subscriber that his line has become connected with a first selector switch and that he may, therefore, commence dialing the digits of the wanted line number.

It will be assumed that the line with which the calling subscriber desires a connection is located in a distant office which may be reached over an idle automatic ticketing trunk and that this trunk is reached over a first selector **200**, a second selector **201** and a third selector **202** in response to the dialing of the three office code digits of the desired line number. It will further be assumed that the trunk **300** of Fig. 3 is idle and that following the setting of the third selector **202** in response to the third office code digit dialed, this trunk is seized. Immediately following its seizure, it becomes associated with an idle sender, such as sender **400**, over the sender-connector **321**. The calling subscriber may have proceeded to dial the next or thousands digit of the desired line number before the idle sender became associated with the trunk to receive the next digit dialed on one of its digit registers. The trunk is therefore provided with a digit register **303** individual thereto which is rendered available to receive the dialed digit immediately following the seizure of the trunk. In the case assumed the thousands digit will be registered by the trunk register and the remaining numerical digits dialed by the calling subscriber will be thereafter registered by registers of the sender.

As disclosed more fully in the application of A. J. Busch hereinbefore referred to, the trunk **300** may also be seized directly from a first selector on calls to other offices in the toll area in which case the trunk is seized in response to the dialing of the first office code digit. The second code digit dialed is then registered by the trunk register and the third code digit and all numerical digits are then registered in the sender. The trunk may also be seized from the banks of second selector switches on calls to other offices in the toll area in which case the trunk is seized in response to dialing the first two office code digits. The third code digit is then registered by the trunk register and the numerical digits are registered in the sender. In order that information regarding the one or more code digits dialed to reach the trunk may be recorded for later use in controlling the extension of the connection from the trunk to the called office, and for controlling the printing of a toll ticket, the trunk is provided with a called office code identifying circuit **302**.

When the sender **400** has registered one digit which in one of the cases previously discussed may be the third code digit, the sender is assured that all of the code digits have been dialed and that information with respect thereto has been recorded in the called office code identification circuit **302** or in the identification circuit in combination with the trunk register and a register of the sender and then proceeds to associate itself with an idle decoder over the decoder-connector **420**. The decoder-connector comprises a plurality of multicontact relays one for each sender and one for each decoder. If, as assumed, the decoder **490** is the first one available for use, relay **421** individual to the sender **400** and relay **422** individual to the decoder **490** will be operated to extend control conductors from the sender to the decoder. Over one of these conductors the sender informs the decoder as to which trunk group the trunk **300** is located in and proceeds to operate a multicontact relay **441** of the trunk decoder-connector **440** which has access to the trunk. If the decoder is successful in its attempt to seize the connector **440**, it will establish a connection over the decoder-connector **420** through the sender **400** and over a cross-point of the sender-connector **321** for operating relay **306** in the trunk. This relay upon operating causes the operation of relay **442** in the trunk decoder-connector **440**. With relay **306** of the trunk and relays **442** and **441** of the connector **440** operated, control conductors are extended from the called office code identifying circuit **302** and the terminal bank of the digit register **303** of the trunk to the decoder for transferring information concerning the office code digit or digits dialed to reach the trunk and the code digit or thousands digit registered by register **303**.

If three code digits were dialed to reach the trunk **300**, the entire information concerning those digits will be furnished to the decoder from the office code identifying circuit **302** and the thousands digit registered by the trunk register **303** will also be transferred to the decoder. If two code digits were dialed to reach the trunk information concerning these digits will be furnished to the decoder from the office code identifying circuit **302** and the third code digit registered by the register **303** will be transferred to the decoder and if but one code digit was dialed to reach the trunk, information concerning this digit will be furnished to the decoder from the office code identifying circuit **302** and the second code digit registered by the register **303** and the third code digit registered in the sender will be transferred to the decoder. Having received the code digit information, the decoder may make a translation thereof if necessary and proceed to transfer

the information which it has received or the translated information to registers of the sender. The sender upon receiving the office code information proceeds to control selector switches (not shown) to extend a connection from the trunk to the wanted office and to control selector switches in accordance with the setting of its numerical registers to further extend the connection to the wanted line. The registration of the office code and numerical digits of the wanted line in the sender is also effective in conditioning the printer control circuit **401** associated therewith for later controlling the tape ticket printer **304** of the trunk **300** over the trunk sender-connector **460** having access to the group of trunks in which the calling trunk **300** is located. For this purpose relay **307** of the calling trunk is operated over a cross-point of the sender-connector **321** from the sender and in operating causes the operation of multicontact relay **461** of the connector **460** which relay is individual to the calling trunk group and multicontact relay **462**, which is individual to the sender **400**, is operated from the sender. Thus during the setting of selector switches to complete the desired connection, the printer control equipment of the sender may also function to control the printing on the toll ticket the information which the sender has received.

Calling line identification

Following the seizure of the decoder a starting ground is connected to conductor **491** thereby causing the operation of start relay **800** of the identification circuit forming a part of decoder **490**. Relay **800** upon operating supplies off-normal ground to the register circuits of Figs. 8 to 12, inclusive, and establishes an operating circuit for start relay **811** extending from battery through the winding of relay **811**, conductor **812** of cable **700** extending to the timing circuit of Fig. 7, a contact of relay **701**, which is normally operated, conductor **813** of cable **700**, back contact of relay **814**, thence serially over the upper back contacts of register relays **801** to **810**, inclusive, conductor **815**, No. 5 back contacts of advance relay **1220**, conductor **816**, outer lower back contact of repeat test relay **817** to ground at the inner lower front contact of start relay **800**. It will be noted that this circuit will be closed only if the register relays **801** to **810** of the thousands group register circuit are normal indicating that they are in condition to receive a registration and if relay **701** is operated indicating that the timing circuit of Fig. 7 is in normal condition and that the tone responsive register relays **601** to **610** of the identification circuit are unoperated. It will be noted that under normal conditions, relay **701** is held operated in a circuit from battery over the upper back contacts of relays **601** to **610**, in series, conductor **611**, upper back contact of relay **702**, winding of relay **701**, lower back contact of relay **703**, conductor **704** to ground at the back contact of relay **649**.

Relay **811** upon operating locks over its middle lower front contact and the lower back contact of relay **817** to ground at the inner lower contact of start relay **800**; closes a circuit for progress lamp **818** to indicate that the identification circuit has been started to register the thousands group identification digit of a calling line, which circuit extends from battery, through lamp **818**, upper front contact of start relay **811**, conductor **819**, upper back contact of start relay **911**, conductor **919**, upper back contact of start relay **1011**, conductor **1019**, upper back contact of start relay **1111**, conductor **1119** to ground at the upper back contact of start relay **1211**; prepares at its inner lower front contact a locking circuit for any subsequently operated register relay of the group **801** to **810**; prepares at its lower front contact a locking circuit for advance relay **820** and establishes a circuit from battery over the upper back contact of relay **820**, the inner upper front contact of relay **811**, conductor **821** to ground through the winding of cut-in relay **203** in the thousands group identification connector circuit disclosed in the right portion of Fig. 2. This connector circuit has access to a group identification circuit individual to the calling office and common to all decoders comprising a plurality of multicontact relays such as **210** to **215**, etc., having access to the sleeve conductors of all line finders in the office and ten one thousand group and line-finder subgroup identification circuits, that one appertaining to the No. 0 thousands group of line finders serving the No. 0 thousands line group being disclosed in full and the similar circuits appertaining to the No. 1 thousands group of line finders serving the No. 1 thousands line group being indicated by the box **216**.

If the thousands group identification circuits have not been taken for use by another decoder and therefore neither relay **204** nor **205** individual to other decoders is at the time operated, a circuit for relay **206** and other similar relays connected in parallel therewith will therefore be closed from ground over the upper back contact of relay **205**, upper back contact of relay **204**, upper front contact of relay **203**, winding of relay **206** and lower back contact of relay **209** to battery and relay **206** and the multiple connected relays upon operating will lock over their inner lower front contacts to battery independently of relay **209**. At its lower normal contact relay **203** removes operating ground from the windings of relays **204** and **205** to prevent their subsequent operation thus preventing more than one decoder from simultaneously seizing the common thousands group identification circuits. At its four upper contacts relay **206** establishes obvious circuits for multicontact relays **210** to **213** which upon operating connect the line-finder sleeve conductors of all line finders serving the No. 0 thousands group of line to the No. 0 thousands group identifying circuits and at its four lower contacts establishes circuit for four multicontact relays **214** to **215**, of which only two are shown, which upon operating connect the line-finder sleeve conductors of all line finders serving the No. 1 thousands group of lines to the No. 1 thousands group identifying circuits indicated by the box **216**. Other relays not shown which were operated in parallel with relays **206** similarly cause the operation of other groups of multicontact relays to connect the sleeve conductors of other groups of line finders serving the Nos. 2 to 9 thousands groups of lines to other thousands group identifying circuits similar to that disclosed.

When all of the multicontact relays have become operated a chain circuit is established from ground over their upper front contacts to battery through the winding of relay **209** which at its back contact opens the initial operating circuit for relay **206** and other multipled relays and at its upper front contact establishes a circuit from ground thereover over the inner upper front contact of relay **206**, conductor **500** to battery through the winding of switching relay **502** and in parallel therewith over conductor **501** to battery through the winding of switching relay

612. With relay 502 operated, the input circuits of the ten amplifier-detector circuits of Fig. 6, the No. 0 of which is fully disclosed in the dot-dash rectangle 630 and the Nos. 1 and 2 of which are partially indicated by the rectangles 621 and 622, are connected over the contacts of relay 502 and the conductors of cable 223 to the ten thousands group identifying circuits of Fig. 2 and the circuits controlled by relays 601, 602 to 610, from the anode relays 631 to 640 of the amplifier-detector circuits are connected to the operating windings of register relays 801 to 810 of the thousands group register circuit of Fig. 8.

Each amplifier-detector circuit, for example circuit 630, comprises an input transformer 613, a pentode type amplifying tube 614, a detector tube 615 and an anode relay 640. The anode relay of each circuit is a polarized relay normally held against its back contact by a secondary polarizing winding. As disclosed, the filaments of all amplifier tubes are heated in a series circuit from battery 616, the filaments of all detector tubes are heated in a series circuit from battery 617 through the resistance network 618, and grid biasing potential for all detector tubes is derived from battery 617 and resistance network 618. But preferably two filament heating circuits each supplying the filaments of five amplifying tubes and two filament heating circuits and grid biasing networks each supplying the heating current and grid bias for five detector tubes would be provided. Battery 619 supplies anode potential through the upper windings of the anode relays such as 640 to the anodes of all detector tubes and through resistances such as 620 to the anodes of all amplifier tubes.

Relay 612 upon operating establishes a circuit from ground over its No. 3 contacts, conductor 822 of cable 823, inner lower back contact of relay 817 to battery through the winding of relay 824 which operates and connects current from the 135-cycle source 825 to conductor 842 which is at the time connected through the decoder-connector 420, sender 400 and sender-connector 321 to the sleeve conductor 308 of trunk 300 and thence over the sleeve conductors of the connection established from the calling line 100 over the selector switches 200, 201 and 202 to the sleeve conductor 107 of the line finder 106 which has served the connection and over the sleeve brush 109 of such line finder to the sleeve conductor 108 of the calling line. At its No. 1 contacts relay 612 also establishes a circuit from ground over such contacts, conductor 705 to battery through the lower winding of relay 641 and in parallel therewith through the winding of relay 703. Relay 703 operates to release relay 701 thereby opening the initial starting circuits for relays 811, 911, etc., of the register circuits, to prepare an operating circuit for any one of the tone responsive relays 601 to 610 by connecting ground over its outer lower front contact, over the upper transfer contacts of relay 706 and conductor 707 to the armatures of the anode relays of the amplifier-detector circuits and to perform other functions to be later described. Relay 641 being marginal does not operate at this time.

With alternating current now applied to sleeve conductor 107 of line finder 106 which is located in the No. 5 line-finder group of the master group serving the No. 0 thousands line group, current now flows therefrom over the next to upper front contact of relay 210, through condenser 217, resistance 218, primary winding of the No. 5 subgroup transformer 235 to ground through the primary winding of the No. 0 thousands line group transformer 220. Transformer 235 is ineffective at this time since its secondary windings are in open circuits but transformer 220 is effective to inductively apply the tone current upon the primary winding of input transformer 613 of the amplifier-detector circuit 630 since switching relay 502 has been operated, over a circuit extending from the right terminals of the secondary windings of transformer 220, inner left back contact of relay 221, conductor 222 of cable 223, next to uppermost contacts of relay 502, conductor 503, primary windings of input transformer 613, conductor 504, upper contacts of relay 502, conductor 224 of cable 223, next to inner left back contact of relay 221, to the left terminals of the secondary windings of transformer 220. Thus current is impressed by transformer 613 upon the input circuit of amplifier tube 614, is amplified by this tube and tube 615 detecting the presence of the current operates the anode relay 640 to close its contacts.

It will be recalled that relay 703 of the timing circuit was operated following the operation of switching relay 612 and therefore upon the operation of anode relay 640 a circuit is closed from ground applied to conductor 707 by the operation of relay 703, over the contacts of relay 640, through the winding and transfer contacts of relay 610, conductor 708 to battery at the upper back contact of relay 706. Relay 610 thereupon operates, locking over its transfer contacts to battery.

The timing circuit of Fig. 7 is used in connection with the amplifier-detector circuits in making each of the five identification tests. Due to using the sleeve circuits of line finders and selectors for conducting the identification tests, there may be a number of surges involved in the sleeve circuit during the making of the tests. These surges are due to the charge and discharge of the condensers connected to the sleeve circuits, such as condenser 217, because of calls being initiated and disconnected on lines being served by the line finders involved in each test. Also, surges will be involved due to selectors hunting past selector bank terminals over which an identification test is being made. Also very short surges would be involved due to the bridging conditions at the connectors and at the line-finder banks of the sleeve circuits under identification. In order to avoid false operation of the register relays 601 to 610 at the outputs of the amplifier-detector circuits, the connection of the circuits from the contacts of the anode relays such as 640 to the register relays is controlled by the timing circuit.

This timing circuit is provided with three cold cathode tubes 709, 710 and 711 for which anode current is supplied from the source 712 over conductor 720 to the windings of their associated anode relays 713, 714 and 715 by the operation of relay 703. Relay 703 when it operated started the first timing cycle by connecting ground to the right cathode of tube 709 over the lower normal contacts of relay 706, by opening at its upper back contact the short circuit or discharging circuit through resistance 732 for the timing condenser 716 associated with the tube 709 and by establishing a charging circuit for condenser 716 extending from ground through the condenser, resistance 717 and the inner lower contact of relay 703 to battery 712. After an interval in the order of one-tenth second, the condenser 716 becomes charged and potential from

the source 712 applied through resistances 717 and 718 to the control cathode of tube 709 is effective to fire the tube over a circuit traced from the source 712 to the control cathode, thence across the cathode gap of the tube over the lower normal contacts of relay 706 to ground connected to conductor 719 over the middle lower front contact of relay 703. Condenser 716 discharges over the cathode circuit and the anode relay 713 is operated over a circuit extending from source 712 over conductor 720, through resistance 721, winding of relay 713, anode-cathode path of the tube to ground connected to the right cathode of the tube. Relay 713 upon operating establishes a circuit for relay 706 extending from battery through its winding, over the contacts of relay 713 to ground on conductor 719, and relay 706 locks over its lower alternate contacts directly to ground on conductor 719; removes ground potential from the right cathode of tube 709 thereby extinguishing the tube and releasing anode relay 713; removes operating battery and direct operating ground at its upper normal contacts from the circuits of register relays 601 to 610 and at its inner lower front contact establishes a charging circuit for condenser 722 through resistance 723 to battery connected to conductor 720. The operation of relays 713 and 706 thus terminates the first timing interval. At this time any of the register relays 601 to 610 which have been operated due to the detection of alternating current on a line-finder sleeve conductor or due to surge conditions on the line-finder sleeve conductors are held operated over their locking circuits under control of the operated anode relays of the amplifier-detector circuits, ground being supplied to such locking circuits over conductor 707 through the upper winding of marginal relay 641, winding of relay 649, conductor 724 and the lower front contacts of relay 703. Relay 649 operates in this circuit and opens at its back contact another point in the circuit of relay 701.

Condenser 722 charges over the circuit previously traced since the short circuit or discharge path therefor through resistance 732 is opened at the middle upper back contact of relay 703 and after another one-tenth-second interval becomes fully charged whereupon potential from the source 712 applied through resistances 723 and 725 to the control cathode of tube 710 is effective to fire the tube over a circuit traced through resistance 723, thence through resistance 725 across the cathode gap of the tube over the lower normal contacts of relay 702 to ground on conductor 719. Condenser 722 discharges over the cathode circuit and the anode relay 714 is operated over a circuit extending from source 712 over conductor 720 through resistance 726, winding of relay 714, the anode-cathode path through the tube to ground connected to the right cathode of the tube over the lower normal contacts of relay 702. Relay 714 upon operating establishes a circuit for relay 702 extending from battery through its winding over the contacts of relay 714 to ground on conductor 719 and relay 702 locks over its lower alternate contacts directly to ground on conductor 719; removes ground potential from the right cathode of tube 710 thereby extinguishing the tube and releasing anode relay 714; at its upper back contact opens another point in the circuit of relay 701; at its inner lower front contact establishes a charging circuit for condenser 727 through resistance 728 and the back contact of relay 725 to battery on conductor 720; at its inner upper front contact prepares a circuit for operating a register relay of the thousands line group register circuit of Fig. 8 and at its upper contact establishes a circuit for the repeat test relay 817 of the thousands line group register circuit if no register relay of the group 601 to 610 has been operated. This latter circuit may be traced from ground over the inner upper front contact of relay 702, conductor 729, lower back contacts of the register relays 601 to 610, in series, conductor 730, upper contact of relay 702, conductor 731, No. 2 contacts of relay 612, conductor 826 of cable 823 to battery through the winding of relay 817. Relay 817, if operated, locks over its inner lower front contact and conductor 822 of cable 823 to ground at the No. 3 contacts of relay 612 and functions in a manner to be later described. The operation of relays 714 and 702 thus terminates the second timing interval. Before the end of this interval any of the register relays 601 to 610 which were operated due to surge conditions should have released due to the opening of their locking circuits by the release of the associated anode relays and only the register relay which operated in response to detecting the tone current should remain operated. The register relays are made slow to release in order that they will not release during the false ground conditions which occur during selector hunting over the banks of selectors.

If it be assumed that at the end of the second timing interval more than one of the register relays remain operated, marginal relay 641 will be operated and the timing circuit proceeds to measure a third interval by charging condenser 727 over the circuit previously traced, the short circuit or discharging circuit of this condenser through resistance 732 being at the time opened at the inner upper back contact of relay 703. After an interval of approximately one second the condenser 727 becomes charged and potential from the source 712 applied through resistances 728 and 733 to the control cathode of tube 711 is effective to fire the tube over a circuit traced from source 712 to the control cathode and thence across the cathode gap of the tube to ground on the right cathode of the tube. Condenser 727 now discharges over the cathode circuit and anode relay 715 is operated over a circuit extending from the source 712, over conductor 720, through resistance 734, winding of relay 715, the anode-cathode path through the tube to ground on the right cathode of the tube. Relay 715 upon operating closes an obvious circuit for relay 735 which closes an alarm circuit and establishes a circuit for the repeat test relay 817 of the thousands line group register circuit which may be traced from ground at the front contacts of relay 641, over conductor 736, upper front contacts of relay 735, conductor 731, thence as traced to battery through the winding of relay 817.

If the repeat test relay 817 operates either because no register relay of the group 601 to 610 has operated or because at the end of the third timing interval more than one of the register relays is operated, it locks over its inner lower front contact to ground on conductor 822; opens at its lower back contact the locking circuit of start relay 811 which thereupon releases since its operating circuit was opened at the timing circuit by the release of relay 701; releases relay 624 to remove the tone current and establishes a circuit from ground at the inner lower front con-

tact of relay 800, over its upper front contacts, back contact of counting relay 827 and winding of counting relay 828 to battery. Relay 828 operates and locks through its winding and the winding of relay 827 over the right contacts of relay 823 to ground at the inner lower front contact of relay 800, but relay 827 does not operate in this locking circuit until relay 817 later releases. If desired, relay 828 may cause the lighting of a lamp in a circuit over its left contacts to indicate that a first repeat test has been required. Relay 811 upon releasing opens the previously traced circuit for relay 203 which releases in turn causing the release of relay 206 and the relays multipled therewith, the release of multicontact relays 210 to 215, etc., and the release of relay 209. Relay 206 upon releasing opens the operating circuit for switching relays 502 and 612 whereby such relays release, relay 612 in turn releasing the start relay 703 of the timing circuit and relay 641. With relay 703 released all operated relays of the timing circuit are released, the discharge paths for the timing condensers 716, 722 and 727 are established to insure that the condensers are fully discharged preparatory to another timing operation and the circuit of relay 701 is reestablished.

Upon the release of switching relay 612, the locking circuit of relay 817 is opened whereupon the counting relay 827 is permitted to operate. With relay 701 in the timing circuit reoperated, indicating that the timing circuit has been fully restored to normal and relay 817 released, the initial operating circuit for start relay 811 is reestablished and the circuits are then reoperated to seize the common thousands group identifying circuits of Fig. 2, to reoperate the switching relays 502 and 612, to reoperate relay 824 to again apply alternating current to the line-finder sleeve conductor of the established connection and to proceed with a second test for the current on the line-finder sleeve conductor in the manner previously described. Should the test again fail the timing circuit will again operate relay 817 which will lock as before, release start relay 811 and relay 824 and will operate counting relay 829 in a circuit from ground at the inner lower front contact of relay 800, upper contacts of relay 817, front contact of relay 827, left back contact of relay 830, to battery through the winding of relay 829. Relay 829 will operate and lock in a circuit through its winding and the winding of relay 830 over the right contact of relay 829 to ground at the inner lower front contact of relay 800 and will close a circuit for a lamp over its left contacts, if required, to indicate that the second repeat test has failed. As before, relay 811 upon releasing releases relay 203 resulting in the release of relay 206 and the relays multipled therewith, the release of the multicontact relays 210 to 215, etc., the release of switching relays 502 and 612 and the restoration of the timing circuit. When switching relay 612 releases, relay 817 releases permitting the operation of counting relay 830 in the locking circuit of relay 829. Following the release of the timing circuit and the reoperation of relay 701 with relay 817 released, the initial energizing circuit of start relay 811 is reestablished and relay 811 reoperates to start a second repeat test. Should this second repeat test fail and relay 817 be again operated, a circuit will be established from ground at the inner lower front contact of relay 800, over the upper contacts of relay 817, left front contacts of relays 827 and 830 to an alarm indicating that these tests have failed. At this time relay 811 is not released following the operation of relay 817. Since, with relay 830 operated, it is locked over its middle lower front contact and the right contact of relay 830 to ground at the inner lower front contact of relay 800, and further retests are therefore blocked. With relay 811 held operated, the circuit of progress lamp 813 is held closed.

It will be assumed, however, that the thousands line group test is made successfully and that register relay 610 is operated and locked as previously described. Therefore, when relay 702 of the timing circuit operated as previously described and with no other register relay operated, a circuit is completed from ground at the inner upper front contact of relay 702, over conductor 729, lower back contact of register relays 601, 602, etc., lower front contact of relay 610, next to upper contacts of switching relay 612, conductor 831 of cable 823, through the upper winding of register relay 810 of the thousands line group register circuit over conductor 832 of cable 823, upper contacts of relay 612 to battery at the upper front contact of register relay 610. Register relay 810 upon operating locks over a circuit from ground through its lower winding and inner lower front contact, winding of relay 814 to battery at the inner lower front contact of relay 811 and at its lower front contact connects ground to conductor 833 of cable 834 which is connected over a contact of decoder-connector 420 to the printer control circuit 401 of the sender 400 to register in the printer control circuit the thousands line group digit 0 of the calling line identification. It will be noted that each register relay such as 810 opens at its lower back contact the locking circuit of the next preceding relay so that it is not possible for more than one register relay to remain operated.

Relay 814 which operated in the locking circuit of register relay 810 establishes an obvious circuit for advance relay 820 and at its upper back contact and the upper back contact of register relay 810, the initial operating circuit for start relay 811 is opened. Relay 811, however, remains operated over the locking circuit previously traced. Relay 820 upon operating locks over its upper front contact under the control of start relay 811 and at its upper back contact opens the previously traced circuit for relay 203 which releases in turn releasing relay 206 and the relays multipled therewith, multicontact relays 210 to 215, etc., and relay 209. Relay 206 in turn releases the switching relays 502 and 612 and relay 612 upon releasing restores the timing circuit to its normal condition in which relay 701 thereof is again operated. Relay 612 upon releasing also opens the circuit of relay 824 which releases to disconnect the source of tone current 825. With relay 701 of the timing circuit now operated, relay 820 closes a circuit for start relay 911 of the line-finder group register circuit which may be traced from battery through the winding of relay 911, conductor 912 of cable 700, contacts of relay 701, conductor 913 of cable 700, back contacts of relay 914 and register relays 901 to 905, conductor 915, No. 4 back contact of relay 1220, conductor 916, lower back contact of relay 917, conductor 835 to ground at the inner lower front contact of relay 820. Relay 911 operates and locks over its middle lower front contact and the lower back contact of relay 917 to ground on conductor 835; opens at its upper back contact the

previously traced circuit for progress lamp 818; closes at its upper front contact the circuit of progress lamp 918; prepares at its lower front contact a locking circuit for relay 920; prepares at its inner lower front contact a locking circuit for register relays 901 to 905 and establishes a circuit extending from ground at the upper back contact of relay 920, over its inner upper front contact, conductor 921 of cable 923 to battery through the winding of switching relay 642 and to battery through the winding of switching relay 505.

With register relay 810 of the thousands line group register circuit operated, a circuit is established from ground over the next to inner lower front contact of relay 800, lower back contact of relay 817, conductor 816, No. 5 contact of relay 1220, conductor 815, back contacts of register relays 801, 802, etc., upper front contact of register relay 810, conductor 836 of cable 837 to battery through the winding of cut-in relay 1401. Relay 1401 upon operating removes operating battery for other cut-in relays of the same group 1400, such as relays 1402 and 1403, appertaining to other decoder circuits, to prevent their operation. If no other cut-in relay of the group has been operated by another decoder, relay 1401 upon operating closes the circuit of relay 1404 extending from battery through the winding of relay 1404, front contact of relay 1401 to ground over the lower back contacts of relays 1402 and 1043. Relay 1404 upon operating causes the operation of four multicontact relays, one of which 1405 is disclosed, which relays constitute a thousands line group connector allocated to the No. 0 thousands group of lines, the contacts disclosed being distributed among the four relays but for simplicity of disclosure being shown as controlled by relay 1405.

It is to be noted that ten groups of cut-in relays, only two of which are disclosed, are provided, each having a cut-in relay for each decoder which controls a separate group of multicontact connector relays. For example, the group 1400 is allocated for controlling groups of thousands connector relays having access to the No. 0 thousands group identifying circuit shown fully in Fig. 2 and comprises the cut-in relay 1401 individual to the first decoder 490 for controlling connector relays 1405, etc., other cut-in relays such as 1402 individual to intermediate decoders such as 485 for controlling other groups of such connector relays (not shown) and a cut-in relay 1403 individual to the last decoder 480 for controlling connector relays 1406, etc. One of these cut-in relays is operated when the No. 0 register relay such as 810 of the thousands line group register circuit of the corresponding decoder is operated. Correspondingly the group 1410 is allocated for controlling other groups of thousands connector relays (not shown) having access to the No. 1 thousands group identifying circuit shown schematically by the box 216 of Fig. 2 and comprises a cut-in relay 1411 individual to the first decoder 490, other cut-in relays 1412 individual to intermediate decoders such as 485 and a cut-in relay 1413 individual to the last decoder 480. One of these cut-in relays is operated when the No. 1 register relay such as 801 of the thousands line group register circuit of the corresponding decoder is operated. Eight other similar groups of cut-in relays for controlling thousands connector relays having access to the Nos. 2 to 9 thousands group identifying circuits are provided, the cut-in relays of which are operable in response to the operation of the Nos. 2 to 9 register relays of the thousands line group register circuits of their corresponding decoders.

Returning to the operation of connector relay 1405 and the associated relays, of the same group, when such connector relays have all operated, a chain circuit is established from ground over contacts thereof, corresponding to contact 1407 and conductor 225 to battery through the winding of relay 221. Relay 221 upon operating short-circuits the secondary windings of the No. 0 thousands transformer 220 over its inner and next to inner left front contacts to render such windings ineffective and at its remaining front contacts establishes operating circuits to such of the multicontact relays 210 to 214, etc., which have access to the sleeve conductors of line finders having access to subscribers' lines of the No. 0 thousands group. In this case, relays 210 to 213 are operated. Had a group of connector relays having access to another thousands group identifying circuit, such as for example 215, been operated, the relay of such circuit corresponding to relay 221 would have been operated to short-circuit the secondary windings of the associated thousands transformer and to operate another group of four multicontact relays, for example, relays of the group 214, 215, etc.

With multicontact relays 210 to 213 operated, sleeve conductors of all line finders having access to the No. 0 thousands group of lines are connected through the primary windings of line finder group transformers 231 to 235 and through the primary winding of thousands transformer 220. With the No. 0 thousands group of connector relays 1405, etc., operated, the secondary windings of transformers 231 to 235 are connected over conductors of cable 1408 and contacts of switching relay 505, previously operated, to the input transformers of the Nos. 1 to 5 amplifier-detector circuits of Fig. 5. Relay 1405 upon operating also establishes a circuit from ground over its lower contact, conductor 841 of cable 837 to battery through the winding of relay 824 which operates and applies 135-cycle current to the sleeve conductor 107 of the line finder 106 used in establishing the assumed connection, whereupon the alternating current flows through condenser 217, resistance 218 and the primary windings of transformer 235 and 220. This current is now induced into the secondary windings of transformer 235 and flows in a circuit which may be traced from the right terminals of the secondary windings of transformer 235 over conductor 226, next to upper contacts of relay 1405, over a conductor of cable 1408, a contact of relay 505 through the primary winding of the input transformer, corresponding to transformer 613, of the No. 5 amplifier-detector circuit (not shown), thence over a second contact of relay 505, a second conductor of cable 1408, the third from upper contacts of relay 1405, conductor 227 to the left terminals of the secondary windings of transformer 235.

In response to the alternating current, the No. 5 amplifier-detector circuit functions to operate its associated anode relay corresponding to anode relay 640. With switching relay 642 operated as previously described and the connector relays 1405, etc., operated, a circuit is closed from ground over the chain contacts of the connector relays corresponding to contacts 1409, conductor 643 of cable 644, No. 1 contacts of relay 642, conductor 705 to battery through the winding of start relay 703 of the timing circuit. Relay

703 thereupon operates releasing relay 701 to open the initial operating circuit of start relay 911 of the line finder group register circuit of Fig. 9, to connect ground to conductor 707 in the operating circuits of register relays 601 to 610 and to start the timing cycles of the timing circuit. The timing circuit then functions as previously described. During the timing cycles, a first repeat test is made by the operation of the repeat test relay 917 of the line-finder group register circuit in response to the operation of relay 702 of the timing circuit if no register relay 601 to 610 has been operated or in response to the operation of relay 735 if more than one register has been operated over a circuit from ground on conductor 731, over the No. 2 contacts of switching relay 642, conductor 926 of cable 923 to battery through the winding of relay 917. Relay 917, if operated, locks over its lower front contact and conductor 922 of cable 923 to ground at the No. 3 contacts of switching relay 642 and releases start relay 911 which in turn releases the switching relays 505 and 642. Relays 505 and 642 release the timing circuit and any operated register relays of the group 601 to 610 and release relay 917 whereupon start relay 911 is reoperated to start a repeat test in the manner previously described in connection with the functioning of the thousands line group register circuit. If an additional repeat test is required, relay 917 will be reoperated from the timing circuit as previously described.

After such repeat tests as are required have been made, register relay 605 (not shown) should remain operated alone in response to the operation of the anode relay of the No. 5 amplifier-detector circuit and with relay 702 of the timing circuit operated, a circuit is closed from ground at the inner upper front contact of relay 702, conductor 729, lower back contact of register relays 601 to 604, inclusive, lower front contact of register relay 605 (not shown) a contact of switching relay 642, conductor 931 of cable 923, upper winding of the No. 5 register relay 905 of the line-finder group register circuit, conductor 932 of cable 923, a contact of switching relay 642, upper front contact of register relay 605 over the upper back contacts of succeeding register relays to battery at the upper back contact of register relay 610.

Relay 905 upon operating locks in a circuit from ground through its lower winding and inner lower front contact, winding of relay 914 to battery at the inner lower front contact of relay 911 and at its lower front contact connects ground to conductor 933 of cable 934 which is connected over a contact of decoder connector 420 to the printer control circuit 401 of the sender 400 to register in the printer control circuit the line-finder group digit 5 indicating that the calling line terminates in the No. 5 subgroup of line finders serving the thousands group previously identified. It will be noted that each register relay such as 905 opens at its lower back contacts the locking circuit of the next succeeding relay so that it is not possible for more than one register relay to remain operated.

Relay 914 which operated in the locking circuit of relay 905, establishes an obvious circuit for advance relay 920 and at its upper back contact and the upper back contact of register relay 905, the initial operating circuit of start relay 911 is opened, relay 911, however, remaining operated over its locking circuit. Relay 920 upon operating locks over its lower front contact under the control of start relay 911 and at its upper back contact opens the previously traced circuit of switching relays 505 and 642 which release restoring the timing circuit to normal and releasing the operated register relay 605. When relay 701 reoperates indicating the normal condition of the timing circuit, relay 920 closes a circuit for start relay 1011 of the line-finder bank register circuit which may be traced from battery through the winding of relay 1011, conductor 1012 of cable 700, contacts of relay 701, conductor 1013 of cable 700, back contacts of relay 1014 and register relays 1001 and 1002, conductor 1015, No. 3 back contact of relay 1220, conductor 1016, lower back contact of relay 1017, conductor 935 to ground at the upper front contact of advance relay 920. Relay 1011 operates and locks over its inner lower front contact and the back contact of relay 1017 to ground on conductor 935; opens at its upper back contact the previously traced circuit for progress lamp 918; closes at its upper front contact the circuit for progress lamp 1018; prepares at its lower front contact the locking circuit for relay 1020; prepares at its middle lower front contact a locking circuit for register relays 1001 and 1002, and establishes a circuit from ground at the upper back contact of relay 1020 over its inner upper front contact and conductor 1021 of cable 1023 to battery through the winding of switching relay 645 and to battery through the winding of switching relay 506.

With register relay 905 of the line-finder group register circuit operated, a circuit is established from ground over the inner lower front contact of relay 820, conductor 835, back contact of relay 917, conductor 916, the No. 4 back contact of relay 1220, conductor 915, upper back contacts of register relays 901 to 904, upper front contact of register relay 905, conductor 936 of cable 937, a contact of thousands connector relay 1405, conductor 1305 of cable 1306, to battery through the winding of relay 1315. Relay 1315 upon operating closes an obvious circuit for four multicontact relays, one of which 1325 is shown, which constitute a line-finder group connector relay having access to the calling line sleeve conductors of two hundred lines in the No. 0 thousands group served by the No. 5 line-finder group of that thousands group. Had the No. 1 register relay 901 of the line-finder group register circuit being operated to connect ground to conductor 940 of cable 937, then a circuit would have been completed over conductor 1301 to operate relay 1311 which in turn would operate four multicontact relays, one of which 1321 is shown, which constitute a line-finder group connector relay having access to the calling line sleeve conductors of two hundred lines in the No. 0 thousands group served by the No. 1 line-finder group of that thousands group. Since each thousands group of lines has five two-hundred line subgroups, five of such groups of connector relays are provided each selectively operable by one of the five register relays 901 to 905 of the line-finder group register circuit. It is to be understood that a maximum of nine other circuits similar to that disclosed in Fig. 13 would be provided each associated with a group of thousands connector relays such as are disclosed in Fig. 14.

When the four multicontact relays of the line-finder group connector including relay 1325 have operated, a chain circuit is established from ground over the lower contact of each relay, conductor 1326 of cable 1306, third from lower con-

tact of relay 1405, conductor 646 of cable 644, No. 1 contacts of operated switching relay 645, conductor 705 to battery through the winding of start relay 703 of the timing circuit which operates to start the timing cycles, to release relay 701 which opens the initial operating circuit of start relay 1011 of the line-finder bank register circuit, relay 1011, however, remaining operated over its locking circuit, and to connect ground to conductor 707 in the operating circuits of register relays 601 to 610. Relay 824 is at this time operated over a circuit previously traced under the control of the operated thousands group connector relay 1405.

With the line-finder group connector relays including relay 1325 operated and the thousands group connector relays including 1405 operated, the sleeve conductors of the two hundred lines in the No. 0 thousands group to which line finder 106 of the No. 5 line-finder group has access are connected over contacts of relay 1325, conductors of cable 1307, contacts of relay 1405, conductors of cable 1414 to the bank, bank level and terminal identifying circuits of Fig. 5 which are individual to the decoder 490. The two hundred conductors thus extended from the two-hundred line sleeves are grouped in twenty groups of ten each, corresponding to the twenty levels in the two line-finder banks. Each conductor terminates in a serially connected condenser and resistance and each group of ten conductors is multipled to one terminal of the primary winding of a level transformer such as 520. The other terminals of the primary windings of the ten level transformers 511 to 529 appertaining to the ten groups of conductors connected to the sleeves of lines terminating in the upper line-finder bank are multipled together and connected to ground through the primary winding of the upper bank transformer 508 and the other terminals of the primary windings of the ten level transformers 521 to 530 appertaining to the ten groups of conductors connected to the sleeves of lines terminating in the lower line-finder bank are multipled together and connected to ground through the primary winding of the lower bank transformer 507. The secondary windings of bank transformers 507 and 508 are connected over conductors of cable 509 and contacts of operated switching relay 506 to the input transformers of the No. 1 and No. 2 amplifier-detector circuits 621 and 622.

It has been assumed that the calling line 100 terminates in the No. 2 terminal of the upper or No. 0 level of the upper bank of line finder 106 and therefore with the 135-cycle current applied from the source 825 to the sleeve conductor 107 of line finder 106 and thence over the sleeve brush 109 of the line finder to sleeve conductor 108 of the calling line, the current is conducted from sleeve conductor 103 over a contact of relay 1325, over a conductor of cable 1307, a contact of relay 1405, and a conductor 1415 of cable 1414, through condenser 531, resistance 532 and primary windings of transformers 520 and 508 to ground. This current is induced into the secondary windings of bank transformer 508 and flows over conductors of cable 509 and the upper contacts of switching relay 506 to the primary winding of the input transformer, corresponding to transformer 613, of the No. 2 amplifier-detector circuit 622 and is amplified and detected to operate an anode relay similar to anode relay 640.

Since the start relay 703 of the timing circuit has been previously operated, the operation of the anode relay causes the operation of register relay 602. The timing circuit functions as previously described. During its timing cycles a first repeat test is made by the operation of repeat test relay 1017 of the line-finder bank register circuit if no register relays 601 to 610 have been operated or if more than one of such relays has been operated by the connection of ground to conductor 731 through the operation of either relay 702 or 735 of the timing circuit, in a circuit extending over the No. 2 contacts of switching relay 645 and conductor 1026 of cable 1023 to battery through the winding of relay 1017. Relay 1017, if operated, locks over its lower front contact and conductor 1022 of cable 1023 to ground at the No. 3 contacts of switching relay 645 and releases start relay 1011 in turn releasing the switching relays 506 and 645. Relay 645 releases any operated register relays of the group 601 to 610, releases the timing circuit, relay 1017 is released and start relay 1011 is reoperated to start another test in the manner previously described. If an additional repeat test is required, relay 1017 will be reoperated from the timing circuit by the operation of either relay 702 or 735 thereof as previously described.

After such repeat tests as are required have been made, register relay 602 should remain operated alone in response to the operation of the anode relay of the No. 2 amplifier-detector circuit 622 and with relay 702 of the timing circuit operated, a circuit is closed from ground at the inner upper front contact of relay 702, conductor 729, lower back contact of register relay 601, lower front contact of register relay 602, a contact of switching relay 645, conductor 1031 of cable 1023, upper winding of register relay 1002 of the line-finder bank register circuit, conductor 1032 of cable 1023, a contact of switching relay 645, upper front contact of register relay 602, over the upper back contacts of succeeding register relays to battery at the upper back contact of register relay 610.

Relay 1002 upon operating locks in a circuit from ground through its lower winding and inner lower front contact, winding of relay 1014, to battery at the middle lower front contact of relay 1011 and at its lower front contact connects ground to conductor 1033 of cable 1034 which is connected over a contact of decoder-connector 420 to the printer control circuit 401 of the sender 400 to register in the printer control circuit the line-finder bank digit 2 indicating that the calling line terminates in the No. 2 or upper bank of a line finder. It will be noted that each register relay 901 and 902 opens at its lower back contact the locking circuit of the other relay so that it is not possible for more than one register relay to remain operated.

Relay 1014, which operated in the locking circuit of relay 1002, establishes an obvious circuit for advance relay 1020 and at its upper back contact and the upper back contact of register relay 1002, the initial operating circuit of start relay 1011 is opened, relay 1011, however, remaining operated over its locking circuit. Relay 1020 upon operating locks over its upper front contact under the control of start relay 1011 and at its upper back contact opens the previously traced circuit for switching relay 506 and switching relay 645 which release restoring the timing circuit to normal and releasing the operated register relay 602. When relay 701 reoperates indicating the normal condition of

the timing circuit, relay 1020 closes a circuit for start relay 1111 of the line-finder bank level register circuit which may be traced from battery through the winding of relay 1111, conductor 1112 and cable 700, contacts of relay 701, conductor 1113 of cable 700, back contacts of relay 1114 and register relays 1101 to 1110, conductor 1115, No. 2 bank contact of relay 1220, conductor 1116, back contact of relay 1117, conductor 1035 to ground at the lower front contact of advance relay 1020. Relay 1111 operates and locks over its inner lower front contact and the back contact of relay 1117 to ground on conductor 1035; opens at its upper back contact the previously traced circuit for progress lamp 1018; closes at its upper front contact the circuit of progress lamp 1118; prepares at its middle lower front contact a locking circuit for register relays 1101 to 1110; prepares at its lower front contact a locking circuit for relay 1120 and establishes a circuit from ground at the upper back contact of relay 1120 over its inner upper front contact and conductor 1121 of cable 1123 to battery through the winding of switching relay 647 and to battery through the winding of switching relay 533.

With register relay 1002 of the line-finder bank register circuit operated, a circuit is established from ground over the inner upper front contact of relay 920, conductor 935, back contact of relay 1017, conductor 1016, No. 3 back contact of relay 1220, conductor 1015, upper back contact of register relay 1001, upper front contact of register relay 1002, conductor 1036 of cable 1037 to battery through the windings of relays 534 and 535 in parallel. Had register relay 1001 of the line-finder bank register circuit been operated indicating that the calling line terminated in the lower-bank of a line finder then a circuit would have been completed over conductor 1040 of cable 1037 for operating relays 536 and 537. With relays 534 and 535 operated a circuit is established from ground over the inner contacts of relay 534, the outer contacts of relay 535, conductor 538 of cable 539, No. 1 contacts of switching relay 647, conductor 705 to battery through the winding of start relay 703 of the timing circuit which relay operates to start the timing cycles, to release relay 701 which opens the initial operating circuit of start relay 1111 of the line-finder bank level register circuit, relay 1111, however, remaining operated over its locking circuit and to connect ground to conductor 707 in the operating circuits of register relays 601 to 610. Relay 824 is at this time operated over the circuit previously traced under the control of the thousands group connector relay 1405.

Relay 535 performs no further function at this time, but relay 534 upon operating connects the secondary windings of bank level transformers 511 to 520 over contacts of the operated switching relay 533 to the primary windings of the input transformers of the ten amplifier-detector circuit 621 to 630. It has been assumed that the calling line 100 terminates in the No. 0 bank level of the upper or No. 2 bank of line finder 106 and therefore with the 135-cycle current applied from the source 825 to the sleeve conductor 108 of the calling line, this current again flows through the primary winding of the No. 0 level transformer 520 thereby inducing current in a circuit extending through the secondary windings of transformer 520 over the upper contacts of switching relay 533 and through the primary windings of input transformer 613 of the No. 0 amplifier-detector circuit 630 whereupon the anode relay 640 thereof is operated.

Since the start relay 703 of the timing circuit has been previously operated, the operation of anode relay 640 causes the operation of register relay 610. The timing circuit proceeds to function as previously described. During the timing cycles a first repeat test is made by the operation of repeat test relay 1117 of the line-finder bank level register circuit in response to the operation of either relay 702 or 735 of the timing circuit over a circuit extending from ground applied to conductor 731 over the No. 2 contacts of switching relay 647, conductor 1126 of cable 1123 to battery through the winding of relay 1117. Relay 1117, if operated, locks over its right front contact and conductor 1122 of cable 1123 to ground at the No. 3 contacts of switching relay 647 and releases start relay 1111 in turn releasing the switching relays 533 and 647. Relay 647 upon releasing releases any operated register relays of the group 601 to 610 and the timing circuit and relay 1117 is released and start relay 1111 is reoperated to start another test in the manner previously described. If an additional test is required, relay 1117 will be reoperated from the timing circuit as previously described.

After such repeat tests as are required have been made, register relay 610 should remain operated alone in response to the operation of anode relay 640 and with relay 702 of the timing circuit operated, a circuit is closed from ground at the inner upper front contact of relay 702 over conductor 729, lower back contacts of register relays 601 to 609, inclusive, lower front contact of register relay 610, a contact of switching relay 647, conductor 1131 of cable 1123, upper winding of register relay 1110 of the line-finder bank level register circuit, conductor 1132 of cable 1123, a contact of switching relay 647 to battery over the upper front contact of register relay 610.

Relay 1110 upon operating locks in a circuit from ground through its lower winding and lower front contact, winding of relay 1114 to battery at the middle lower front contact of relay 1111 and at its inner upper front contact connects ground to conductor 1133 of cable 1134 which is connected over a contact of decoder-connector 420 to the printer control circuit 401 of the sender 400 to register in the printer control circuit the line-finder bank level digid 0 indicating that the calling line terminates in the No. 0 bank level of a line finder. It will be noted that each register relay 1101 to 1110 opens at its lower back contact the locking circuit of preceding register relays so that it is not possible for more than one register relay to remain operated.

Relay 1114 which operated in the locking circuit of relay 1110 establishes an obvious circuit for advance relay 1120 and at its upper back contact and the upper back contact of relay 1110, the initial operating circuit of start relay 1111 is opened, relay 1111, however, remaining operated over its locking circuit. Relay 1120 upon operating locks over its upper front contact under the control of start relay 1111 and at its upper back contact opens the previously traced circuit for switching relays 533 and 647 which release restoring the timing circuit to normal and releasing the operated register relay 610. When relay 701 reoperates indicating the normal condition of the timing circuit, relay 1120 closes a circuit for start relay 1211 of the line terminal register cir-

cuit which may be traced from battery through the winding of relay 1211, conductor 1212 of cable 700, contacts of relay 701, conductor 1213 of cable 700, back contacts of relay 1214 and register relays 1201 to 1210, back contact of relay 1217, conductor 1135 to ground at the lower front contact of advance relay 1120. Relay 1211 operates and locks over its inner lower front contact and the back contact of relay 1217 to ground on conductor 1135; opens at its upper back contact the previously traced circuit for progress lamp 1113; closes at its upper front contact the circuit of progress lamp 1218; prepares at its middle lower front contact the locking circuit for register relays 1201 to 1210; prepares at its lower front contact a locking circuit for advance relay 1220 and establishes a circuit from ground at the No. 8 back contact of relay 1220, over its inner upper front contact, conductor 1221 of cable 1223 to battery through the winding of switching relay 648 and to battery through the winding of switching relay 540.

With register relay 1110 of the bank level register circuit operated, a circuit is established from ground over the lower front contact of relay 1020, conductor 1035, back contact of relay 1117, conductor 1116, No. 2 back contact of relay 1220, conductor 1115, upper back contact of register relays 1101 to 1109, upper front contact of register relay 1110, conductor 1136 of cable 1137, next to upper front contact of relay 535 and winding of relay 550 to battery. Had any one of the other register relays 1101 to 1109 been operated, indicating that the calling line terminated in another of the bank levels, a similar circuit would have been established to a corresponding one of the relays 541 to 549 there being one of these relays for each bank level of an upper line-finder bank. Similarly, had relay 536 been previously operated indicating that the calling line terminates in a lower line-finder bank level, one of the relays 561 to 560 would have been operated dependent upon which one of the corresponding bank level register relays 1101 to 1110 was operated. With relay 550 operated, a circuit is established from ground over its upper contact, conductor 510 of cable 536, No. 1 contacts of switching relay 648, conductor 795 to battery through the winding of start relay 703 of the timing circuit which operates to start the timing cycles, to release relay 701 which opens the initial operating circuit of start relay 1211 of the line terminal register circuit, relay 1211, however, remaining operated over its locking circuit, and to connect ground to conductor 707 in the operating circuits of register relays 601 to 610. Relay 824 is at the time operated over the circuit previously traced under the control of the thousands group connector relay 1405.

Relay 550 upon operating connects each of the group of ten conductors of cable 1408, connected over the contacts of relays 1405 and 1325 to the sleeve conductors of the ten lines terminating in the line-finder bank level previously identified, that is the No. 0 level of the upper bank of line finder 106, to ground through a condenser and resistance. It has been assumed that the calling line 109 terminates in the No. 2 terminal of the No. 0 bank level of the upper bank of line finder 106 and therefore with the 135-cycle current applied from the source 825 to the sleeve conductor 108 of the calling line this current flows from conductor 108 over contacts of relays 1325 and 1405, conductor 1415 of cable 1414, the next to inner front contact of relay 550, through condenser 562, resistance 572 and resistance 582 to ground and in parallel with resistance 582 over contacts of switching relay 540 through the primary winding of input transformer of the No. 2 amplifier-detector circuit 622 whereupon its anode relay is operated. If the calling line terminated in another terminal of the identified level, the current flowing through one of the other resistances 581, 583 to 590 would have caused the operation of a corresponding anode relay 631, 633 to 640.

Since the start relay 703 of the timing circuit has been previously operated, the operation of the anode relay of the No. 2 amplifier-detector circuit 622 causes the operation of register relay 602. The timing circuit proceeds to function as previously described. During the timing cycles a first repeat test is made by the operation of repeat test relay 1217 of the line terminal register circuit in response to the operation of either relay 702 or relay 735 of the timing circuit over a circuit extending from ground applied to conductor 731 over the No. 2 contacts of switching relaly 648, conductor 1226 of cable 1223 to battery through the winding of relay 1217. Relay 1217, if operated, locks over its right front contact and conductor 1222 of cable 1223 to ground at the No. 3 contacts of switching relay 648 and releases start relay 1211 which in turn releases switching relays 540 and 648. Relay 648 releases any operated register relays of the group 601 to 610 and the timing circuit, and relay 1217 is released whereupon start relay 1211 is reoperated to start another test in the manner previously described. If an additional test is required, relay 1217 will be reoperated from the timing circuit as previously described. After such repeat tests as are required have been made, register relay 602 should remain operated alone and with relay 702 of the timing circuit operated, a circuit is closed from ground at the inner upper front contact of relay 702, conductor 729, lower back contact of register relay 601, lower front contact of register relay 602, a contact of switching relay 648, conductor 1231 of cable 1223, upper winding of register relay 1202 of the line terminal register circuit, conductor 1232 of cable 1223, a contact of switching relay 648, upper front contact of register relay 602, upper back contacts of succeeding register relays to battery at the upper back contact of register relay 610.

Relay 1202 upon operating locks in a circuit from ground through its lower winding and lower front contact, lower back contacts of succeeding register relays including relay 1210, winding of relay 1214 to battery at the middle lower front contact of relay 1211 and at its inner upper front contact connects ground to conductor 1233 of cable 1234 which is connected over a contact of decoder-connector 420, to the printer control circuit 401 of the sender 400 to register in the printer control circuit the line terminal digit 2 indicating that the calling line terminates in the No. 2 termnal of a bank level of a line finder. It will be noted that each register relay 1201 to 1210 opens, at its lower back contact, the locking circuits of preceding register relays so that it is not possible for more than one register relay to remain operated.

Relay 1214 which operated in the locking circuit of relay 1202 establishes a circuit for relay 1220 which extends from battery through the winding of relay 1220, front contact of relay 1214, upper front contact of relay 1202, upper back contact of relay 1201, back contact of relay

1217 to ground on conductor 1135 and at its upper back contact and the upper back contact of relay 1202, the initial operating circuit of start relay 1211 is opened, relay 1211, however, remaining operated over its locking circuit. Relay 1220 upon operating locks over its No. 7 front contact under the control of relay 1211; opens at its No. 8 back contact, the previously traced operating circuit for switching relays 540 and 648, which release restoring the timing circuit to normal and releasing the operated register relay 602; at its Nos. 2 to 5 contacts, opens the initial operating circuits of all start relays 811, 911, 1011, 1111 and 1211; at its No. 6 contacts opens the circuit of a time counter if required, which has been counting the total time for the calling line identification and at its No. 1 contact establishes a circuit from ground over conductor 1240 to signal the decoder that the calling line identification has been completed and that the printer control circuit 401 of the sender may proceed to control the printer 304 of the trunk 300 to print the calling line identification digits registered in the printer control circuit. Since the digits registered identify the calling line on a line-finder terminal basis, it will be necessary in considering the data printed on the toll ticket to translate these digits into the appropriate directory number. The various classes of subscribers' lines in an office may be segregated in different bank levels of the line finder groups so that the registration which is made to record the bank level will also denote the class of the line involved.

The decoder then opens the circuit of start relay 800 which releases in turn releasing all operated relays of the calling line identification circuits of Figs. 2 and 5 to 14, inclusive. As soon as the decoder 490 has completed its calling line identification function, it is disconnected from the sender and when the sender has completed its functions of setting up the connection to the wanted line and of controlling the printer to print the calling line identification digits and the digits of the wanted line designation, its connections to the trunk 300 over the sender connector 321 and trunk sender-connector 460 are released. The connection from the calling line to the wanted line over the trunk 300 is then maintained until the calling subscriber restores his receiver to the switchhook. Following the response of the called subscriber and until the connection is released following the termination of the conversation, the printer 304 of the trunk 300 may be controlled at intervals by the Telechron clock timer 305 to print information on the toll ticket indicative of the elapsed time intervals of the conversation.

Operation of two decoder identification circuits at the same time

The decoder identification circuits are arranged so that more than one can be used simultaneously by different senders, but due to the chain arrangement of the cut-in relays 203, 204, 205 individual to the decoder identification circuits, the common thousands group identification circuits of Fig. 2 may be used for making the thousands group test by but one decoder identification circuit at any one time. However, after one decoder identification circuit has completed the thousands line group test, its cut-in relay is released and thereafter another decoder identification circuit may then attempt to identify a calling line through the operation of its individual cut-in relay such as 204 or 205, provided such calling line is not in the thousands line group which has been made busy by the first decoder identification circuit through the operation of the thousands group relay of such circuit such as relay 221. In case the second decoder identification circuit desires to identify a line which is in an idle one-thousand line group, there will be no interference in the operation between the two decoder identification circuits as the 135-cycle circuit connected to a line-finder sleeve conductor by the second decoder identification circuit will not be received in the busy thousands line group identification circuit. For example, if as previously assumed the No. 0 thousands line group identification circuit was made busy by a first decoder, identification circuit through the operation of relays 221 and 210 to 213 then the line-finder sleeve conductors connected over the contacts of relays 210 to 213 appertain only to the No. 0 thousands group and the sleeve of any line finder not in this group would therefore not appear in the contacts of such relays and the application of tone current to any such sleeve by another decoder identification circuit would not reach the first decoder identification circuit.

In the event that a second decoder identification circuit desires to identify a line which is in a one-thousand line group circuit in which a first decoder identification circuit is working the 135-cycle current placed on the line-finder sleeve by the second decoder identification circuit may cause two amplifier-detector circuits in the first decoder identification circuit to function, one in response to the alternating current applied from the first decoder identification circuit and another in response to the alternating current applied from the second decoder identification circuit. As under this condition two of the register relays of the group 601 and 610 at the output of the amplifier-detector circuits will be operated, marginal relay 641 will be operated and since in the second identification circuit the start relay 811 of the thousands group register circuit is operated, a circuit is established over the lower front contact thereof and the inner upper back contact of relay 820 through the winding of relay 738 of the timing circuit of each of the other decoder identification circuits. The operation of relay 738 of the timing circuit of the first decoder identification circuit, with relay 641 operated, will establish a circuit from ground over the contacts of relay 641, conductor 736, contacts of relay 738 to battery through the winding of relay 725 and relay 725 upon operating will disconnect the source 712 from the charging circuit of timing condenser 727 associated with the tube 711, and will close a discharge circuit for such condenser thereby preventing the measurement of the third timing interval. This also blocks the line-finder group register circuit of the first decoder identification circuit since relay 735 of the timing circuit cannot be operated to recycle the line-finder group test which the first decoder identification circuit is making.

The second decoder identification circuit, which is making the one-thousand line group test, will not receive the 135-cycle tone current applied thereby to a line-finder sleeve since the relay of the busy thousand line group identification circuit, for example, relay 221, has been operated by the first decoder identification circuit and therefore when the timing circuit of the second decoder identification circuit operates relay

702, none of the register relays 601 to 610 at the output of its amplifier-detector circuits will be operated and the previously traced circuit extending over the No. 2 contacts of switching relay 612 to the winding of repeat test relay 817 will therefore be closed and relay 817 will operate to release start relay 811 and to release relay 824 to disconnect the tone source 825. Relay 817 upon operating locks under the control of switching relay 812 as previously described. Since at this time advance relay 820 of the first decoder identification circuit is operated, this identification circuit now being engaged in making the line-finder group or some other succeeding test, a circuit is established from ground over the lower contact of relay 820 to battery through the winding of relay 737 of the timing circuit of the other decoder identification circuits and the operation of relay 737 of the second decoder identification circuit with relay 820 of the first decoder identification circuit operated will establish a circuit from ground over the lower front contact of relay 817 of the second decoder identification circuit over conductor 838, contacts of relay 737, back contact of relay 735 and conductor 501 to battery through the winding of switching relays 502 and 612 of the second decoder identification circuit for holding these relays operated following the release of relay 811 as previously described. With relay 612 held operated, relay 817 is held operated to prevent the reoperation of relay 811 to start recycling and the timing circuit is prevented from releasing. The timing circuit therefore proceeds to measure a third timing interval of one second at the termination of which relay 735 thereof operates to open the previously traced holding circuit of switching relays 502 and 612 which now release to release the timing circuit and relay 817. Relay 817 upon releasing and with the timing circuit in normal condition permits start relay 811 to reoperate to start a repeat test and to permit the reoperation of relay 824 to reapply the 135-cycle current.

During the one-second interval as measured by the timing circuit of the second decoder identification circuit as just described, during which the 135-cycle current has been removed, one of the register relays 601 to 610 of the group at the output of the amplifier-detector circuits of the first decoder identification circuit should have released thereby releasing relays 641 and 725 to restart the third one-second timing interval and since relay 702 of this timing circuit is at the time operated, the line-finder group test, as well as all the other identification tests, should have been completed in the first decoder identification circuit, whereby the thousand line group circuit is released so that it may be free for use by the second decoder identification circuit.

Recycling test

The decoder identification circuits are so arranged that in the event no signal is received on any one of the five identification tests, the repeat test relay of the register circuit is operated at the end of a second timing period of the associated timing circuit. The operation of the repeat test relay will cause the test to be repeated in the same manner as the original test. Each register circuit is arranged with four counting relays operable by the operation and release of the repeat test relay as described hereinbefore in connection with repeat test relay 817 and counting relays 827 to 830 of the thousands group register circuit, so that three repeat tests may be made on each test. In making the thousands line group test, if no register relay 801 to 810 is operated on the third repeat test, the start relay 811 is held operated, the test is blocked and an alarm circuit is closed by the operation of counting relay 830 as previously described. In case the identification circuit is making the second or line-finder group test, the second operation of the repeat test relay 917 to initiate the second repeat test will cause the operation of counting relay 929 in a circuit from battery through the winding of relay 929, left back contact of counting relay 930, front contact of previously operated counting relay 927, upper contacts of relay 917 and conductor 914 to ground at the lower contact of relay 809. Upon the conclusion of the second repeat test when relay 917 releases, counting relay 930 operates in the locking circuit of relay 929 extending from battery through the windings of relays 929 and 930 in series, right front contact of relay 929 to ground on conductor 941 and when relay 917 reoperates to start a third repeat test, closes a circuit for operating repeat test relay 817 of the thousands line group register circuit extending from battery through the winding of relay 817, conductor 839, left front contacts of relays 930 and 927 over the upper contacts of relay 917 to ground on conductor 941.

Relay 817 upon operating and if the thousands group register circuit has not been blocked by the operation of counting relay 830 thereof, will open at its lower back contact the locking circuit of start relay 811 which will release in turn releasing any operated register relay of the group 801 to 810 to restore the corresponding register relay of the printer control circuit 401 of the sender and to release the operated thousands group connector relay such as 1405 and the operated thousands group identification circuit relay such as 221. Relay 811 also releases advance relay 820 which in turn opens at its inner upper front contact, the locking circuit of start relay 911 which upon releasing opens the circuit of switching relays 505 and 642 which are operated during the line-finder group identification test. On the release of switching relay 642, the timing circuit is restored ot normal and relay 917 is released in turn releasing relay 817. Relay 817 upon releasing and with the timing circuit normal recloses the previously traced operating circuit for start relay 811 which then proceeds to repeat the thousands group test in the manner previously described. This procedure is to insure that the thousands group test had been made correctly before making a third repeat test in the line-finder group register circuit.

This recycling is accomplished in each of the five register circuits in the manner just described so that in case a register relay was operated falsely on one identification test, the identifying test in the following register circuit would indicate no signal and would cause the recycling on the previous tests before giving an alarm. With this arrangement there appears to be little likelihood of identifying the incorrect line terminal except on the last or line terminal test. In the last test only ten individual line sleeves are involved and the number of false surges which might cause a false registration is consequently very small and therefore the probability of obtaining a false signal on this test should be small.

While in the foregoing discussion the invention has been described in connection with a system in which line finders are employed to extend

connections to first selector switches, it is to be understood that the invention is equally applicable to systems employing rotary or Keith type line switches.

What is claimed is:

1. In a telephone system, a plurality of lines divided into groups and subgroups, groups of line finders having access respectively to said subgroups of lines, means responsive to the extension of a connection from a calling line over one of said line finders for connecting a source of alternating current to a conductor of said extended connection and, line identifying means common to said lines responsive to the current on said conductor to produce a group of signals constituting an identification of said calling line comprising circuit networks selectively connectable to said conductor on the outgoing side of said line finder for producing certain of said signals and other circuit networks selectably connectable to said conductor on the line side of said finder switch for producing others of said signals.

2. In a telephone system, a plurality of lines divided into groups and subgroups, groups of line finders having access respectively to said groups of lines, each of said groups of line finders being divided into a plurality of subgroups having access respectively to the subgroups of lines of the group, means responsive to the extension of a connection from a calling line over one of said line finders for connecting a source of alternating current to a conductor of said extended connection and, line identifying means common to said lines responsive to the current on said conductor to produce a group of signals constituting an identification of said calling line comprising circuit networks selectively connectable to said conductor on the outgoing side of said line finder for producing certain of said signals to identify the group and the subgroup in which said line is located and other circuit networks selectively connectable to said conductor on the line side of said line finder for producing others of said signals to identify the line-finder bank, the bank level thereof and the bank level terminal in which said line terminates.

3. In a telephone system, a plurality of lines divided into groups and subgroups, groups of line finders having access respectively to said groups of lines, each of said groups of line finders being divided into a plurality of subgroups having access respectively to the subgroups of lines of the group, means responsive to the extension of a connection from a calling line over one of said line finders for connecting a source of alternating current over a conductor of said extended connection to the outgoing side of said line finder and to the line side thereof and, line identifying means common to said lines responsive to the alternating current on said conductor to produce signals constituting an identification of said calling line comprising a group of register circuits, a plurality of current detecting circuits, a plurality of line group circuit networks corresponding in number to said line groups in each of which branches from the conductors of all line finders serving the corresponding line group terminate and each network being divided into a plurality of line-finder group portions equal in number to the number of groups of line finders serving the line group, means for connecting said line group networks to said detecting circuits whereby a first of said register circuits is controlled to register the line group designation of the calling line in response to the detection of said current, means for thereafter connecting the line-finder group portions of the line group network through which said current was detected to said detecting circuits whereby a second of said register circuits is controlled to register the line-finder subgroup designation of the calling line in response to the detection of said current, a line-finder bank, bank level and level terminal circuit network, means for extending branches of the line side of the conductors of any line-finder group of lines in which a conductor having current thereon has been detected to said latter circuit network, said branch conductors being grouped in said network in accordance with the line-finder bank and bank level in which the subgroup of lines terminate, and means for connecting the bank portions of said latter network to said detecting circuits whereby a third of said register circuits is controlled to register the line-finder bank in which the calling line terminates, for connecting the bank level portion of said latter network to said detecting circuits whereby a fourth of said register circuits is controlled to register the bank level in which the calling line terminates and for connecting the level terminal portion of said latter network to said detecting circuits whereby a fifth of said register circuits is controlled to register the bank level terminal in which the calling line terminates.

4. In a telephone system, a plurality of lines divided into groups, groups of line finders having access respectively to said groups of lines, means responsive to the extension of a connection from a calling line over one of said line finders for connecting a source of alternating current over a conductor of said extended connection to the outgoing side of said line finder and, line identifying means common to said lines comprising a line group register circuit, a plurality of current detecting circuits corresponding in number to said line groups each having a register relay associated with its output side, a plurality of circuit networks corresponding in number to said line groups, groups of branches from the outgoing sides of the line finders serving the several line groups terminating respectively in said networks, a line group transformer in each network, means for simultaneously connecting all branches of every group to the primary windings of the transformers of the networks in which said groups of branches terminate and for connecting the secondary windings of said transformers to the inputs of said detecting circuits whereby one of said register relays is operable in response to the detection of said current to register the line group in which the calling line is located, and means for transferring said registration to said line group register circuit.

5. In a telephone system, a plurality of lines divided into groups and subgroups, groups of line finders having access respectively to said groups of lines, each of said groups of line finders being divided into subgroups having access respectively to the subgroups of lines of the group, means responsive to the extension of a connection from a calling line over one of said line finders for connecting a source of alternating current over a conductor of said extended connection to the outgoing side of said line finder and, line identifying means common to said lines comprising a line group register circuit, a line-finder group register circuit, a plurality of current detecting circuits corresponding in number to said line groups each having a register relay associated with its output side, a plurality of circuit networks corresponding

in number to said line groups, groups of branches from the outgoing sides of the line finders serving the several line groups terminating respectively in said networks, each of said groups of branches being divided into subgroups corresponding to the subgroups of line finders serving a line group, a line group transformer and a plurality of line-finder subgroup transformers in each network, means for simultaneously connecting all branches of every group to the primary windings of the line group transformers of the net workers in which said groups of branches terminate and for connecting the secondary windings of said transformers to the inputs of said detecting circuits whereby one of said register relays is operable in response to the detection of said current to operate said line group register circuit to register the line group in which the calling line is located, and means operable in response thereto for simultaneously connecting all branches of every subgroup of branches incoming to the net work through which the current has been detected to the primary windings of the respective line-finder subgroup transformers of said net work and for connecting the secondary windings of such transformers to the inputs of certain of said detecting circuits, whereby one of said register relays is operable in response to the detection of said current to operate said line-finder group register circuit to register the subgroup of line finders in which the calling line terminates.

6. In a telephone system, a plurality of lines divided into groups and subgroups and each subgroup being further divided into line-finder bank subgroups, groups of line finders having access respectively to said groups of lines, each of said groups of line finders being divided into subgroups having access respectively to the subgroups of lines of the group, and each of said line finders having two banks of terminals in which bank subgroups of lines terminate, means responsive to the extension of a connection from a calling line over one of said line finders for connecting a source of alternating current over a conductor of said extended connection to the outgoing side of said line finder and to the line side thereof and, a line identifying means common to said lines comprising a line group register circuit, a line-finder subgroup register circuit, a line-finder bank register circuit, a plurality of current detecting circuits each having a register relay associated with its output side, means responsive to the detection of said current on the line-finder side of said conductor by said detecting circuits for successively operating said line group and said line-finder subgroup register circuits to register the line group and the line-finder subgroup in which the calling line terminates, a circuit network having two line-finder bank transformers, two groups of conductors incoming to said network corresponding to the bank subgroups of any line-finder subgroup of lines, means operable in accordance with the registration of the line group and line-finder subgroup in which the calling line terminates for connecting said conductors to the line side of the identifying conductors appertaining to the line-finder group of lines in which the calling line is located, and means for simultaneously connecting the conductors of each group to the primary winding of the corresponding bank transformer and for connecting the secondary windings of said transformers to the input sides of two of said detecting circuits whereby one of said register relays is operable in response to the detection of said current to control said line-finder bank register circuit to register the line-finder bank in which the calling line terminates.

7. In a telephone system, a plurality of lines divided into groups and subgroups and each subgroup being further divided into line-finder bank subgroups, groups of line finders having access respectively to said groups of lines, each of said groups of line finders being divided into subgroups having access respectively to the subgroups of lines of the group, and each of said line finders having two banks of terminals in which bank subgroups of lines terminate, means responsive to the extension of a connection from a calling line over one of said line finders for connecting a source of alternating current over a conductor of the extended connection to the outgoing side of said line finder and to the line side thereof and, a line identifying means common to said lines comprising a line group register circuit, a line-finder subgroup register circuit, a line-finder bank register circuit, a line terminal register circuit, a plurality of current detecting circuits each having a register relay associated with its output side, means responsive to the detection of said current on the line-finder side of said conductor by said detecting circuits for successively operating said line group and said line-finder group register circuits to register the line group and the line-finder subgroup in which the calling line terminates, a circuit network having two line-finder bank transformers and two groups of bank level transformers, two groups of conductors incoming to said network corresponding to the bank levels of any line-finder subgroup of lines each divided into subgroups corresponding to bank levels, means operable in accordance with the registration of the line group and the line-finder subgroup in which the calling line terminates for connecting said conductors to the line side of the identifying conductors appertaining to the line-finder group of lines in which the calling line is located, means for simultaneously connecting the conductors of each group to the primary winding of the corresponding bank transformer and for connecting the secondary windings of said bank transformers to the input sides of two detecting circuits whereby one of said register relays is operable in response to the detection of said current to control said line-finder bank register circuit to register the line-finder bank in which the calling line terminates, means thereafter operable to connect the level subgroup of the group of said conductors appertaining to the bank in which the calling line was found to terminate to the primary windings of said level transformers and to connect the secondary windings of said transformers to the input sides of said detecting circuits whereby a register relay is operable in response to the detection of said current to operate said bank level register circuit to register the bank level in which the calling line terminates, and means to thereafter connect the level subgroup of conductors corresponding to the bank level in which the calling line was found to terminate to the input sides of said detecting circuits whereby a register relay is operable in response to the detection of said current to operate said level terminal register circuit to register the terminal position in which said calling line terminates.

8. In a telephone system, a plurality of lines divided into groups and subgroups, line identifying conductors divided into corresponding groups and subgroups, means responsive to the

extension of a connection from a calling line for connecting a source of alternating current over a conductor of said extended connection to the identifying conductor of said calling line, and a line identifying means common to said lines comprising a plurality of register circuits for registering the elements of a calling line identification, a plurality of current detecting circuits each having a register relay associated with its output side, means for associating said detecting circuits successively with groups and subgroups of said identifying conductors and for associating said register circuits successively with said register relays, a timing circuit and means controlled by said timing circuit if on any identification test no current is detected during a predetermined interval, for releasing the connection between said register relays and the associated register circuit and the connection between the groups or subgroups of identifying conductors at the time under test and said detecting circuits and for thereafter reestablishing said connections to make a repeat test.

9. In a telephone system, a plurality of lines divided into groups and subgroups, line identifying conductors divided into corresponding groups and subgroups, means responsive to the extension of a connection from a calling line for connecting a source of alternating current over a conductor of said extending connection to the identifying conductor of said calling line, and a line identifying means common to said lines comprising a plurality of register circuits for registering the elements of a calling line identification, a plurality of current detecting circuits each having a register relay associated with its output side, means for associating said detecting circuits successively with groups and subgroups of said identifying conductors and for associating said register circuits successively with said register relays, a timing circuit and means controlled by said timing circuit if on any test more than one of said register relays remains operated after a predetermined interval for releasing the connection between said register relays and the associated register circuit and the connection between the groups or subgroups of identifying conductors at the time under test and said detecting circuits whereby the operated register relays are released and for thereafter reestablishing said connections to make a repeat test.

10. In a telephone system, a plurality of lines divided into groups and subgroups, line identifying conductors divided into corresponding groups and subgroups, means responsive to the extension of a connection from a calling line for connecting a source of alternating current over a conductor of said extended connection to the identifying conductor of said calling line, and a line identifying means common to said lines, comprising a plurality of register circuits for registering the elements of a calling line identification, each of said register circuits having a repeat test relay, a plurality of circuit detecting circuits each having a register relay associated with its output side, means for associating said detecting circuits successively with groups and subgroups of said identifying conductors and for associating said register circuits successively with said register relays, a timing circuit, and means controlled by said timing circuit if on any test no current is detected during a predetermined interval or if after a further predetermined interval more than one of said register relays remains operated for operating the repeat test relay of the associated register circuit whereby the connection between said register relays and the associated register circuit and the connection between the group or subgroups of identifying conductors at the time under test and said detecting circuits are released and said timing circuit is restored to normal and whereby said connections are thereafter reestablished to make a repeat test.

11. In a telephone system, a plurality of lines divided into groups and subgroups, line identifying conductors divided into corresponding groups and subgroups, means responsive to the extension of a connection from a calling line for connecting a source of alternating current over a conductor of said extended connection to the identifying conductor of said calling line, and a line identifying means common to said lines comprising a plurality of register circuits for registering the elements of a calling line identification, each of said register circuits having a repeat test relay, a plurality of current detecting circuits each having a register relay associated with its output side, means for associating said detecting circuits successively with groups and subgroups of said identifying conductors and for associating said register circuits successively with said register relays, a timing circuit and means controlled by said timing circuit if on any test no current is detected during a predetermined interval or if after a further predetermined interval more than one of said register relays remains operated for operating the repeat test relay of the associated register circuit, whereby the connection between said register relays and the associated register circuit and the connection between the group or subgroups of identifying conductors at the time under test and said detecting circuits are released and said timing circuit is restored to normal and whereby said connections are thereafter reestablished to make a repeat test, each of said tests being repeated a plurality of times if no register relay or more than one register relay is operated.

12. In a telephone system, a plurality of lines divided into groups, line identifying conductors divided into corresponding groups, means responsive to the extension of a connection from a calling line for connecting a source of alternating current over a conductor of said extended connection to a line identifying conductor of the group corresponding to the group in which the calling line is located, and a line identifying means common to said lines comprising a line group register circuit having a repeat test relay, a plurality of current detecting circuits each having a register relay associated with its output side, means for associating said detecting circuits respectively with said groups of identifying conductors and for associating said register relays with said register circuit, a timing circuit, means controlled by said timing circuit if no current is detected during a predetermined interval or if more than one of said register relays remains operated following a further predetermined interval for operating said repeat test relay whereby said detecting circuits are dissociated from said groups of identifying conductors, said register relays are dissociated from said register circuit, said timing circuit is restored to normal and said repeat test relay is released and whereby said associating means are reoperated to initiate a repeat test and means controlled by said repeat test relay after two repeat tests have been made

to block further repeat tests and to close an alarm circuit.

13. In a telephone system, a plurality of lines divided into groups and subgroups, line identifying conductors divided into corresponding groups and subgroups, means responsive to the extension of a connection from a calling line for connecting a source of alternating current over a conductor of said extended connection to the identifying conductor of said calling line and, a line identifying means common to said lines comprising a plurality of register circuits for registering the elements of a calling line identification, each of said register circuits having a repeat test relay, a plurality of current detecting circuits responsive to said current each having a register relay associated with its output side, means for associating said detecting circuits successively with groups and subgroups of said identifying conductors and for associating said register circuits successively with said register relays, a timing circuit, means controlled by said timing circuit if on any test no current is detected during a predetermined interval or if after a further predetermined interval more than one of said register relays remains operated for operating the repeat test relay of the associated register circuit to cause a repeat test to be made, each of said tests being repeated a plurality of times if no register relay or more than one register relay is operated, means in each register circuit for counting the number of repeat tests made with respect thereto and means controlled by the counting relays of each register circuit following the first when a predetermined number of repeat tests have been made with respect thereto for causing an additional repeat test to be made with respect to the preceding register circuit.

14. In a telephone system, a plurality of lines divided into groups and subgroups, line identifying conductors divided into corresponding groups and subgroups, a line identifying means common to said lines comprising a plurality of register circuits for registering the elements of a calling line identification, each of said register circuits having a start relay and a plurality of register relays, a plurality of current detecting circuits each having a register relay associated with the output side thereof, means for associating said detecting circuits successively with groups and subgroups of said identifying conductors and for associating said detecting circuit register relays successively with the register relays of said register circuits, means responsive to the extension of a connection from a calling line for seizing said line identifying means, a source of alternating current, means thereafter operative to connect said source of current over a conductor of said extended connection to the identifying conductor of said calling line whereby said detecting circuits are effective to successively cause the operation of the register relays of said register circuits to register the elements of the calling line identification, a timing circuit associated with said detecting circuits and means for preventing the operation of the start relay of any register circuit if at the time any of its register relays are operated, if any of the register relays associated with the detecting circuits are operated or if said timing circuit is not in its normal condition.

15. In a telephone system, a plurality of lines divided into groups and subgroups, line identifying conductors divided into corresponding groups and subgroups, means responsive to the extension of a connection from a calling line for connecting a source of alternating current over a conductor of said extended connection to the identifying conductor of said calling line and, a calling line identifying means common to said lines comprising a plurality of register circuits for registering the elements of a calling line identification, each of said register circuits having a start relay, an advance relay and a plurality of register relays, a plurality of current detecting circuits each having a register relay associated with its output side, switching means for associating said detecting circuits successively with groups and subgroups of said identifying conductors and for associating the register relays associated with said detecting circuits successively with the register relays of said register circuits and means effective upon the operation of a register relay of any register circuit to operate the advance relay thereof to cause the operation of the start relay of the succeeding register circuit and to cause the advance of said switching means.

16. In a telephone system, a plurality of lines divided into groups and subgroups, line identifying conductors divided into corresponding groups and subgroups, means responsive to the extension of a connection from a calling line for connecting a source of alternating current over a conductor of said connection to the identifying conductor of said calling line, and a line identifying means common to said lines comprising a plurality of register circuits for registering the elements of a line identification, a plurality of current detecting circuits each having a register relay associated with its output side, means for associating said detecting circuits successively with groups and subgroups of said identifying conductors and for associating said register circuits successively with said register relays, a timing circuit having a plurality of condenser timed electron devices, means for operating one of said devices a predetermined interval following the association of said detecting circuits with identifying conductors of any groups or subgroups, means effective upon the operation of said device for releasing any register relays which have been operated by surge conditions on any of the identifying conductors and for causing the operation of the second of said devices after a further predetermined interval, means operable by said second device for causing the dissociation of said detecting circuits from the identifying conductors if none of the register relays has been operated or, if more than one of said register relays has been operated, for causing the operation of said third device after a further interval and, means operable by said third device for causing the dissociation of said detecting circuits from the identifying conductors.

17. In a telephone system, a plurality of lines divided into groups and subgroups, line identifying conductors divided into corresponding groups and subgroups, means responsive to the extension of a connection from a calling line for connecting a source of alternating current over a conductor of said extended connection to the identifying conductor of said calling line and, a line identifying means common to said lines comprising a plurality of register circuits for registering the elements of a line identification, a plurality of current detecting circuits each having a register relay associated with its output side, means for associating said detecting circuits successively with groups and subgroups of said iden-

tifying conductors and for associating said register circuits successively with said register relays, a timing circuit having a plurality of condenser timed electronic devices, means for operating one of said devices a predetermined interval following the association of said detecting circuits with identifying conductors of any groups or subgroups, means effective upon the operation of said device for releasing any register relays which have been operated by surge conditions on any of the identifying conductors and for causing the operation of a second of said electronic devices after a further predetermined interval and, means operable by said second device if but one of said register relays remains operated, for transferring the registration indicated by said relay to the associated register circuit.

18. In a telephone system, a plurality of lines divided into groups, line identifying conductors divided into corresponding groups, line group networks equal in number to said groups of conductors in which said groups of conductors terminate respectively, a plurality of calling line identifying means common to said networks each comprising a line group register circuit, a plurality of current detecting circuits equal in number to said networks each having a register relay associated with its output side and, means for connecting said networks to said detecting circuits and for associating said register relays with said register circuit, means responsive to the concurrent extension of connections from a plurality of said lines for associating an idle identification means with each extended connection, means responsive to the seizure of the first idle identification means for associating it with said networks to the exclusion of other identification means and for connecting a source of alternating current to the identification conductor of the calling line which caused the seizure of said identification means whereby the detecting circuit corresponding to the network in which the calling line identifying conductor terminates is made responsive to operate its associated register relay and to operate said line group register circuit to register the line group in which the calling line terminates and means effective upon the completion of the registration for rendering said networks available for seizure by said other identification means.

19. In a telephone system, a plurality of lines divided into groups, line identifying conductors divided into corresponding groups, line group networks equal in number to said groups of conductors in which said groups terminate respectively, a plurality of calling line identifying means common to said network each comprising a line group register circuit, a plurality of current detecting circuits equal in number to said networks each having a register relay associated with its output side and means for connecting said networks with said detecting circuits and for associating said register relay with said line group register circuit, means responsive to the concurrent extension of connections from a plurality of said lines located in different line groups for associating an idle identification means with each extended connection, means responsive to the seizure of the first idle identification means for associating it with said networks to the exclusion of other identification means and for connecting a source of alternating current to the identifying conductor of the first calling line which caused the seizure of said first identification means whereby the detecting circuit corresponding to the network in which said calling line identifying conductor terminates is made responsive to operate its associated relay and to operate said line group register circuit to register the line group in which the calling line is located and means effective upon the completion of the line group registration of said first line for rendering said networks available for seizure by other seized identification means whereby a second identification means may proceed to register the line group identification of a second calling line.

20. In a telephone system, a plurality of lines divided into groups, line identifying conductors divided into corresponding groups, line group networks equal in number to said groups of conductors in which said groups terminate respectively, a plurality of calling line identification means common to said networks each comprising a line group register circuit, a plurality of current detecting circuits equal in number to said networks each having a register relay associated with its output side and, means for connecting said circuit networks with said detecting circuits and for associating said register relays with said line group register circuit, means responsive to the concurrent extension of connections from a plurality of said lines for associating an idle identification means with each extended connection, means responsive to the seizure of the first idle identification means for associating it with said networks to the exclusion of other identification means and for connecting a source of alternating current to the identifying conductor of the first calling line which caused the seizure of said first identification means whereby the detecting circuit corresponding to the network in which said calling line identifying conductor terminates is made responsive to operate its associated relay and to operate said line group register circuit to register the line group in which the calling line is located, means effective upon the completion of the line group registration for rendering said networks available for seizure by other seized identification means, and means for blocking the operation of the line group register circuit of a second identification means if the second calling line is located in the same line group as said first calling line.

21. In a telephone system, a plurality of circuits to which signaling current or a surge of extraneous current may be applied, a plurality of detecting circuits associable therewith, each having a register relay associable with its output side, a timing circuit having a plurality of condenser timed electron devices, means for operating one of said devices a predetermined interval following the association of said detecting circuits with said first circuits, means effective upon the operation of said device for releasing any register relays which have been operated by surge conditions and for causing the operation of the second of said devices after a further predetermined interval, and means operable by said second device if but one of said register relays remains operated for transferring the registration indicated by said relay.

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