

May 18, 1943

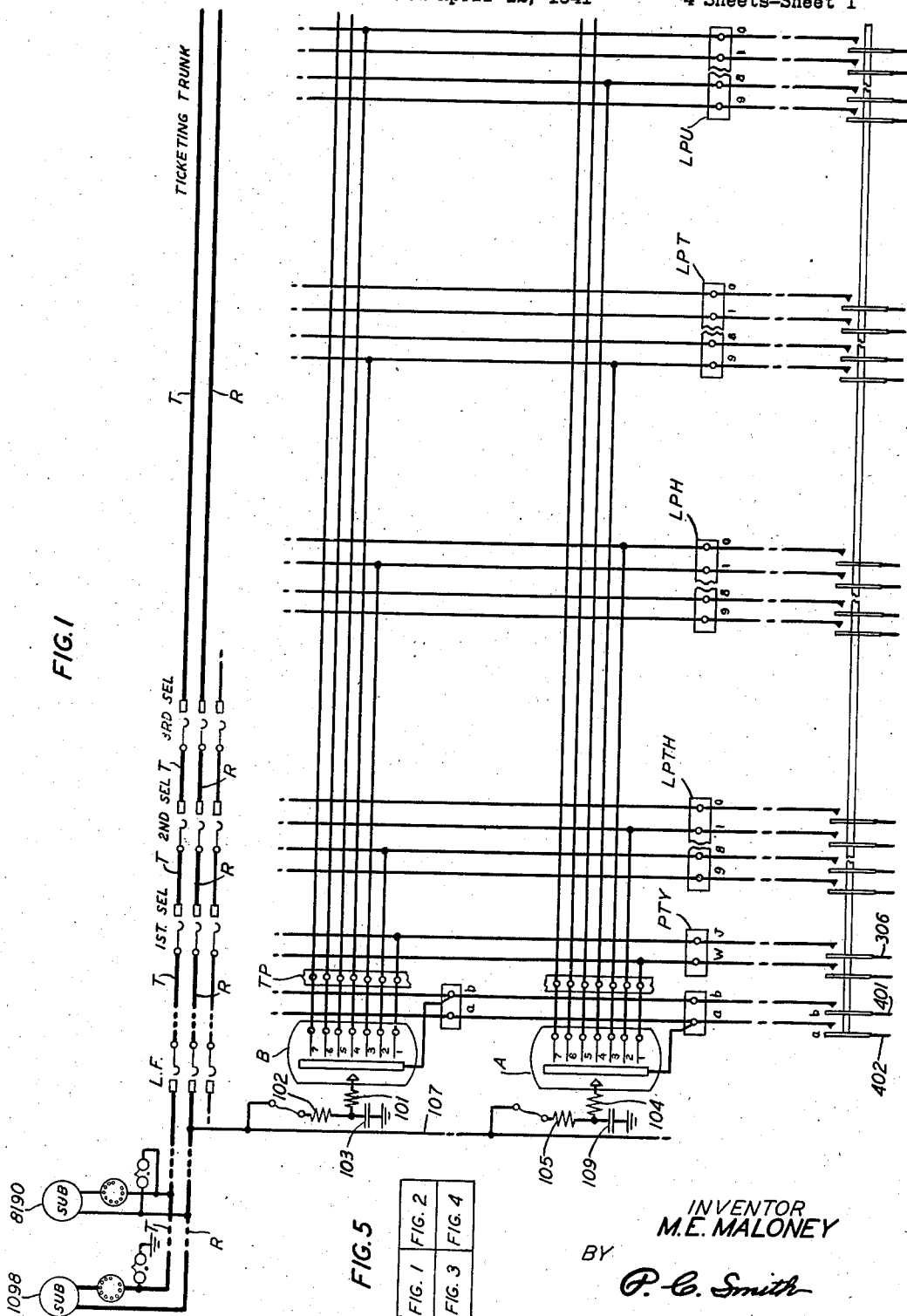
M. E. MALONEY

2,319,424

TELEPHONE SYSTEM

Filed April 12, 1941

4 Sheets-Sheet 1



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M. E. MALONEY

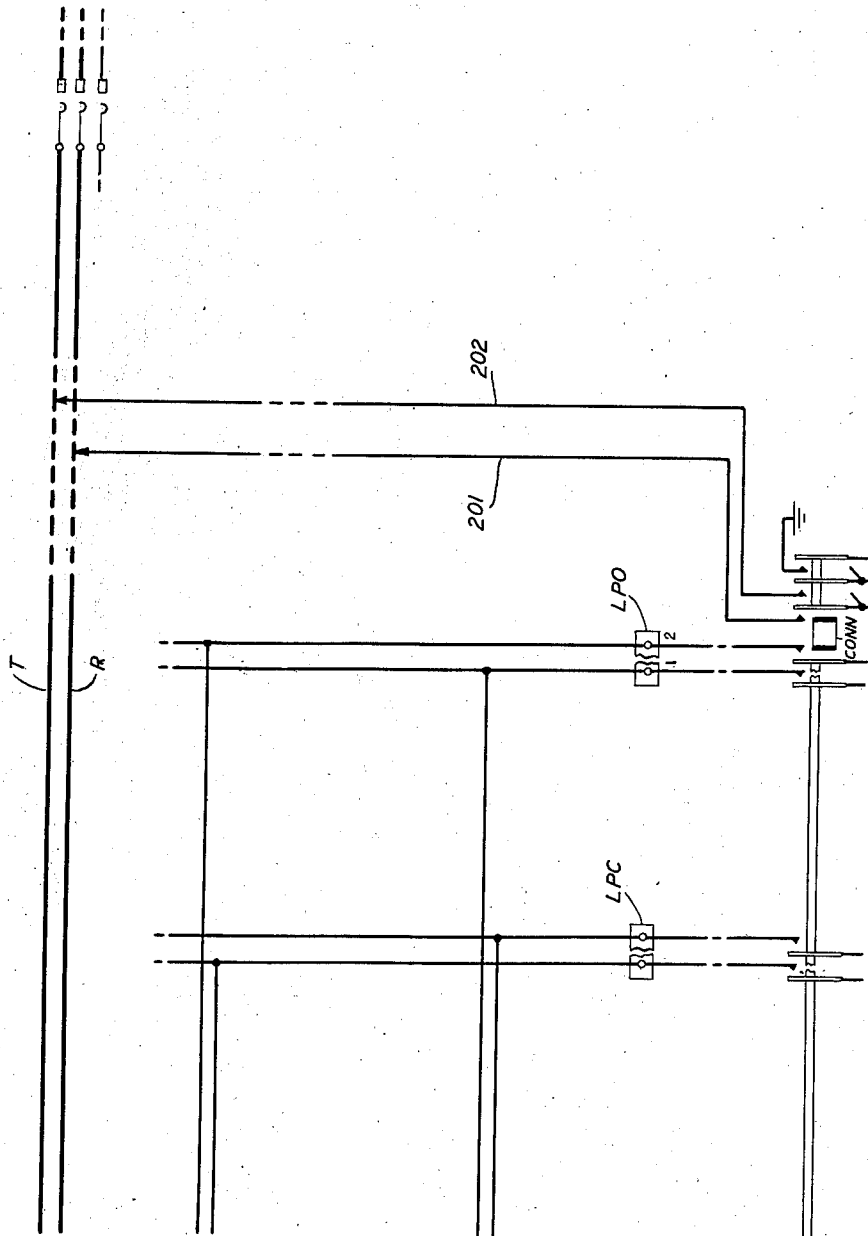
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FIG. 2



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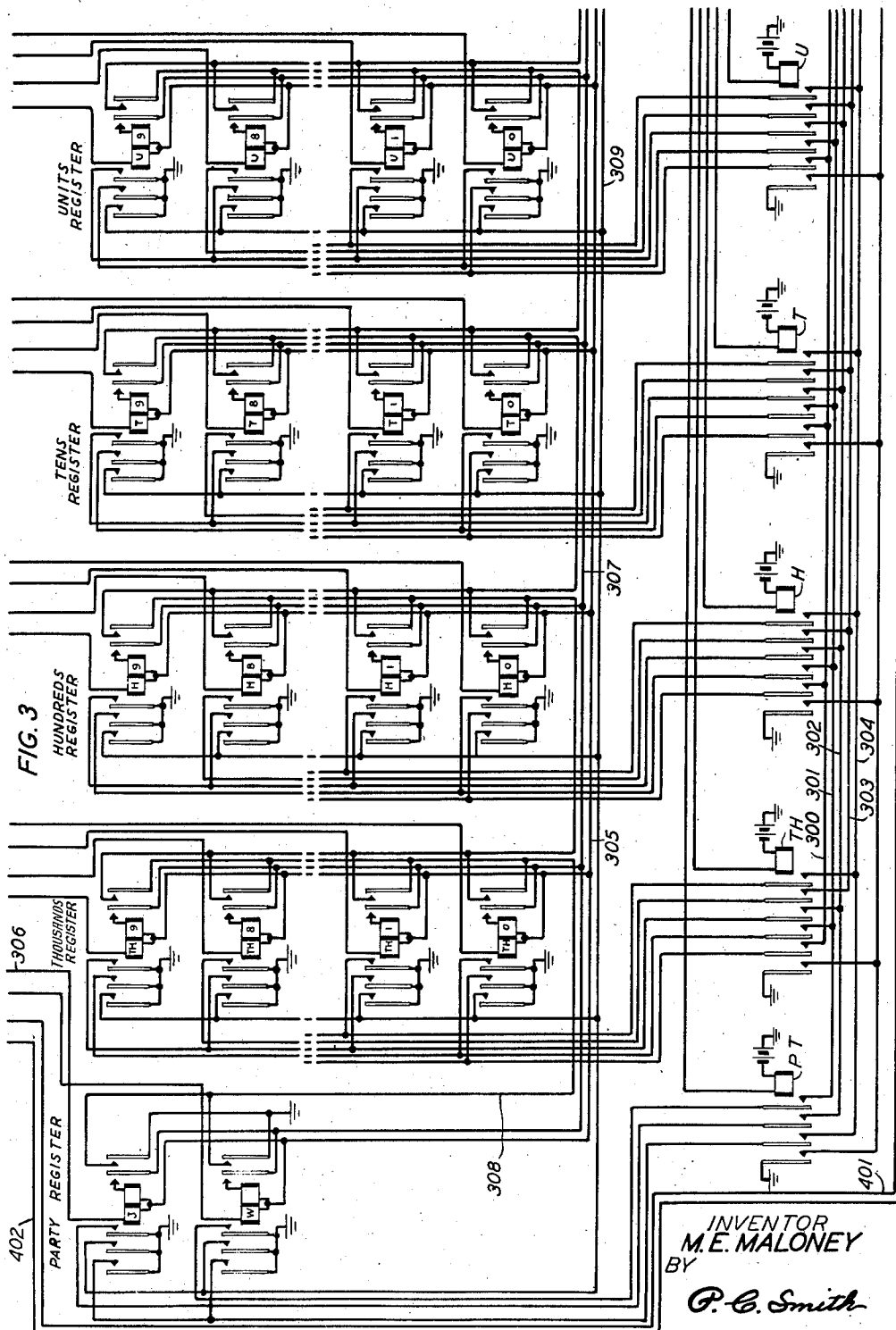
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TELEPHONE SYSTEM

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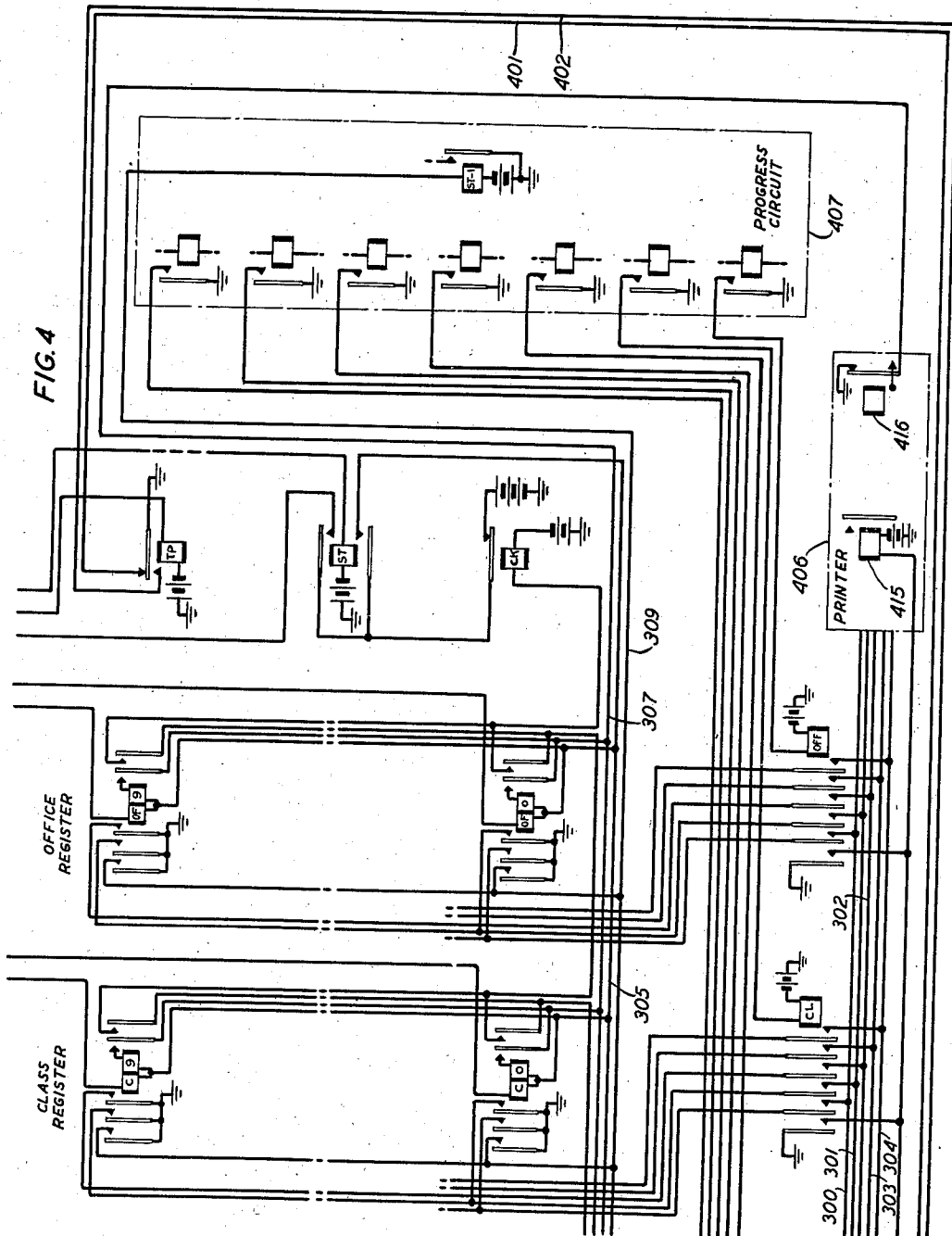
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2,319,424

TELEPHONE SYSTEM

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Application April 12, 1941, Serial No. 388,221

6 Claims. (Cl. 179—27)

This invention relates to telephone systems and more particularly to those systems in which the numerical indication of a calling line is automatically determined and made available.

It is well known that, in certain types of telephone connections such as those, for example, in which a calling station is extended automatically or otherwise to some remote station, it is sometimes necessary to ascertain the number of said calling station in order that charges for the call therefrom may be properly assessed thereto. Such connections are known as toll or long distance connections and, in some types of automatic telephone systems in which the calling station is routed to its destination through the position of a recording operator, the number of the calling station is verified manually by the operator who, after orally ascertaining the number from the calling subscriber, checks it by touching the tip of a so-called checking cord to a pin in a check multiple which is assigned to the given number. If the number as given by the calling party is correct, a tone circuit will be completed over the checking cord and pin and the tone is heard in the operator's telephone set. On the other hand, if the number as given does not correspond to that of the pin to which the tip of the cord has been touched, the tone circuit is not completed and the tone is not heard, a fact which indicates to the operator that the number given by the calling party does not correspond to that of the station from which he is calling and service may then be denied until the discrepancy is rectified.

In automatic telephone systems, it is desirable to have the identity of the calling station ascertained and transmitted automatically to some point at which it may be recorded on settable registers for the visual display of the number, if the call is completed through an operator's position, or for automatically recording the number if the information is to be utilized for operating printing or other recording devices responsive to the setting of the registers.

My invention is principally concerned with the automatic identification of the calling line number and its principal feature is a gas-filled electron device individual to each line that has a pair of main electrodes responsive to an electrical condition applied to the line, a plurality of control electrodes each individual to a characteristic designation of the line, and a plurality of settable registers connectable to the device whereby, upon said device being rendered conductive by said electrical condition applied to

the line, circuits are completed between the registers and the control electrodes of the device that will cause the registers to be set in accordance with the numerical designation on the line.

The setting of the registers may then be utilized, of course, in any manner desired such as, for instance, operating a printing device, or lighting a bank of lamps or transmitting the setting of the registers to a control circuit or sender adapted to utilize the information according to its function.

Another feature of the invention is a novel arrangement of the main electrode of the gas-filled device to determine party line identification should the telephone office to which the invention may be applied include two-party stations upon the same line for each of which an identification would be necessary on calls originating from each one of the stations. In accordance with this feature of the invention, one of the two main electrodes of the device is connected to the ring conductor of the line and a firing voltage is then applied to the two main electrodes of the device associated with the station originating the call.

According to another feature of the invention, means are provided whereby the invention may be utilized in common by two or more telephone office units to provide line identification for the lines in each of the offices. When the invention is adapted for such purpose, the electron device of each line in each office is provided with an additional control electrode for office identification purposes and the register connectable to the device is provided with correspondingly settable means for response thereto to identify the office in which the calling line is located.

According to one embodiment of the invention as adapted to provide identification for each of the stations of a plurality of 10,000 line telephone offices and in which the electronic devices employed may be of the so-called cold cathode gas-filled type well known in the art, which break down and become conducting upon the application of a critical or "breakdown" potential to a control anode thereof, I propose to use one such device, or tube, for each station or, when there is one station to the line, then one per line. Such a tube will have its main anode connected to the ring of the line, its cathode connectable to a source of negative potential, and a plurality of control electrodes (of which there will be one for each character or digit of the line identification including the office of origin for which a record or display is desired), each of which is

connectable to a suitable source of potential through a relay of a settable register. When the station initiates a call, a source of positive potential is applied over that conductor of the line to which the main anode of tubes individual to the calling station is connected, and the difference of potential between that applied to the cathode and that applied over the line to the anode will cause the tube to break down and become conducting, not only in the space between the cathode and main anode but also between the cathode and the control electrodes since the latter are also connected to a source of positive potential through the connectable relays of the settable register. Obviously, these relays will operate and since there is one connected to each control electrode, the operated relays indicate the calling line designation.

As said before, the operated relays of the register may be utilized in any desired manner. Their setting, for instance, may be utilized to provide a record or visual display of the calling line number, or the setting itself may be transmitted to a local or distant register sender for the purpose of controlling ticketing equipment thereat. In other words, the manner in which the registration is utilized, being no part of this invention, may be adapted for whatever purpose is indicated by the character or function of the telephone system to which the invention may be applied.

A clearer conception of the scope and purpose of the invention may be obtained from the following description taken in connection with the appended claims and attached drawings in which:

Fig. 1 shows a typical line of a telephone office, said line having two stations thereon, each provided with a gas-filled tube device, a switching train including a diagrammatic showing of a so-called ticketing truck which may form a part of a connection for a call involving calling line identification, terminal punching facilities for cross-connecting the control electrodes of the various line tubes, and a portion of a connecting relay by which said electrodes may be connected to the relays of a settable register;

Fig. 2 shows the terminating end of the ticketing trunk, the remainder of the terminal punching facilities and the remaining portion of the connecting relay the function of which may be controlled in any suitable manner;

Figs. 3 and 4 show the settable register; while

Fig. 5 shows how Figs. 1 to 4, inclusive, should be disposed relative to each other in order to disclose the invention completely.

Referring now to the drawings, there are provided, as indicated therein, two stations upon one line, namely, station 1098 known as the "tip" party having its ringer connected to the tip conductor and to ground, and station 8190 known as the "ring" party having its ringer bridged across both the tip and ring conductors of the line. Since there are two stations upon the line, a gas-filled tube is provided for each station, there being a similar tube for each station in other lines or, if there is but one station to a line as would be the case for so-called individual lines, then one such tube would be provided for each such line. As shown in the drawings, the two stations may be assumed to have numerical designations 8190 and 1098 as before mentioned. In the ordinary automatic telephone exchange, the line to which the stations are connected would be disposed upon the terminals of a line-

finder bank to which suitable line-finder switches LF would have access whenever a call is initiated thereover, and the connection would then be extended under control of dial pulses over a train of selectors such as, for instance, a first selector (1st sel), a second selector (2nd sel), a third selector (3rd sel) etc. to the terminals of the desired station.

Each tube individual to the station (or line) has a main anode connected to the line, there being a condenser-resistance network connected thereto in the event that the same may be necessary to prevent false operation of the tube on ringing current, although the same may be dispensed with if the value of the ringing voltage permits. Thus, tube A associated with station 1098 has its anode connected through resistances 104 and 105 and conductor 107 to the ring conductor R, the mid-point of said resistances being connected through a condenser 109 to ground, while the tube B associated with line 8190 has its main anode connected through resistances 101 and 102 and conductor 107 to the ring conductor R, the mid-point of said resistances being connected through condenser 103 to ground. In the same way, the main anode of the tubes of all other lines or stations regardless of whether they are tip stations, ring stations or individual line stations are connected to the ring conductors R of such lines through suitable condenser-resistance networks if the same are rendered necessary by the use of high ringing voltages. Otherwise they are connected directly to the ring conductors R.

Each of the individual tubes has a control electrode for each digit or character of the station identification. If, for instance, the station is individual to the line and all it has for identification purposes is its numerical designation, then for a 10,000 line office, its line identification tube would have four such control electrodes, one for each digit of the line identification. On the other hand, if the station in question happens to be on a party line station as those illustrated in the drawings, no control electrode would be necessary to identify the party since such identification could ordinarily be provided through the accounting office of the operating company. Yet, if a record or display of such party identification is necessary, then an additional control electrode should be provided as shown in the drawings. Also, if the various lines in the telephone office are entitled to different classes of service, there would be another electrode to indicate such class, and where two or more offices use the common equipment of the invention, by which is meant a common settable register and a common connecting means whereby such register is connected to the electrodes of the line tubes, it would be necessary to indicate in which of the offices the calling line is located, in which event, there would be, of course, another control electrode to indicate the office.

The control electrodes of all the line tubes are suitably extended to a terminal punching TP whence they are distributed individually to seven other terminal punchings, namely, a punching PTY having a terminal W and a terminal J to either of which is connected the electrode designating the party, a punching LPTH having ten terminals reserved for the thousands designation to one of which is connected the electrode designating the thousands digit of the line, a hundreds punching LPH having ten terminals reserved for the hundreds designation to the proper

terminal of which is connected the electrode designating the hundreds digit, a tens punching LPT and a units punching LPU each having ten terminals reserved for tens and units designations, respectively, to a terminal of each of which are connected the two respective electrodes designating such digits, a class punching LPC having as many terminals as there are classes and to the proper terminal of which is connected the electrode designating the class, and an office terminals punching LPO having as many terminals as there are offices using the common equipment, and to the proper office terminal of which is connected the electrode of the line tube reserved for the office designation. The terminal punchings are, of course, common to all lines as indicated by the vertical conductors extending from the punchings and to which the electrode conductors are connected.

As an example of the distribution of the electrodes, consider the tube B associated with station 8190. Assume, further, that the line is a party line, that it has a four-digit numerical designation, that it is entitled to a particular class of service, and that the identifying equipment shown in Figs. 3 and 4, is used in common by two offices. The tube, therefore, would have seven control electrodes which are so indicated, and they are connected to a primary terminal punching TP whence they are distributed to the seven terminal punchings PTY—LPO in the following order: Electrode 1 is reserved for party designation and since the station is a ring or a "J" station, said electrode would be connected to terminal J on punching PTY; electrode 2 is reserved for the thousands digit and would be connected to terminal 8 on punching LPTH; electrode 3 is reserved for the hundreds digit and would be connected to terminal 1 on punching LPH; electrode 4 is reserved for the tens digit and would be connected to terminal 9 on punching LPT; electrode 5 is reserved for the units digit and would be connected to terminal 0 on punching LPU; electrode 6 is reserved for the class of service designation and would be connected to whatever terminal on punching LPC is reserved for this class, while electrode 7 reserved for the office, would be wired to the terminal 1 or 2 on punching LPO depending upon which of these two numerals designates the office containing the line. The wiring distribution of the electrodes of tube A assigned to station 1098 is similar to that of tube B and may be easily followed on the drawing from the above example.

The number of electrodes supplied for indication purposes is thus a function of the number of separate identifying characters of the line and may be increased or reduced in accordance with the variation in the number of such characters. Thus if no record of the indication of the party designation is required, the same being available from the accounting records of the operating company, electrode 1 may be omitted as will also be the case where no office indication would be required, in which event electrode 7 would be omitted.

The present embodiment of the invention is adapted, by way of illustration, merely to operate a settable register and a printing device shown in Figs. 3 and 4, connection to the former being made through a multicontact relay CONN which may be operated in any suitable manner and by which the control electrodes are connected to the register and the signaling conduc-

tors are connected to the trunk. This is the simplest of the many variety of forms which the invention may take as it is obvious that the register and the connecting and controlling means may form parts of other circuit systems which may be adapted to control the sequential performance of the essential control and line identifying operations described hereinunder.

Considering, now, Figs. 3 and 4, the armatures to the left of relay CONN, except armatures *a* and *b*, are connected to the operating windings of the various register relays. The calling line number register comprises ten relays for each of the digits to be identified, namely, the thousands register comprising relays TH0—TH9, the hundreds register comprising relays H0—H9, the tens register comprising relays T0—T9, the units register comprising relays U0—U9. The party register comprises relays J and W (if the same is necessary), the class register comprises as many relays C0—C9 as there are classes of service, and the office register comprises relays OF0—OF9 to indicate each of the offices in which a line may be located. Each relay in each register is double wound with one of the windings connected, as said before, to an armature of the multicontact relay CONN, said connections being made consecutive in order to group the relays at each register with those electrodes of the various line tubes which identify the digit or character reserved for the register.

The register relays are provided with a locking circuit over conductor 307 to ground on the contacts of a relay 416. Each of the relays is provided, also, with an appropriate number of contact pairs, the armatures of which are all grounded so that when the relay operates, it applies ground via the contacts of a cut-in relay to five conductors 300 to 304, inclusive, in the appropriate combination called for by the following code to indicate the digit or character designated by the operated relay in the registers. Each register relay is further provided with one contact pair with grounded armature which supplies ground to conductor 309 for operating start relay ST1 for a purpose set forth hereinafter.

Table of codes

Register relay operated	Conductors grounded	Digit designated
0.	300, 301	0
1.	302, 304	1
2.	301, 304	2
3.	301, 303	3
4.	300, 304	4
5.	300, 303	5
6.	300, 302	6
7.	303, 304	7
8.	302, 303	8
9.	301, 302	9
J.	302, 304	1
W.	301, 304	2

The groups of five conductors 300—304, inclusive, of each register are extended to the magnets (not shown) of any commercially available printer 406. Thus the left front contacts of the party relays J and W are connected to the armatures of relay PT whereby they may be connected with conductors 301, 302 and 304, those of the thousands register are connected to the armatures of relay TH; those of the hundreds register are connected to the armature of relay H; those of the tens registers are connected to the armatures of relay T; those of the units register are connected to the armatures of relay U, those of the class relays are connected to the armatures

of relay CL while those of the office register are connected to the armatures of relay OFF. Relays PT, TH, H, T, U, CL and OF are operated in cyclical order by any suitable progress circuit 407 which first operates relay PT to connect conductors 301, 302 and 304 to the contacts or relays J and W; then operates relays TH, H, T, U, CL and OF in the order named to connect, in succession, conductors 300-304 to the contacts of each of the registers associated with the separate cut-in relays. Inasmuch as each register will have one of its relays operated at the time of the cut-through to the printer, as will be shortly described, the two conductors in the register group which are grounded by said relay will cause the printer to operate and print the digit designated by said grounded conductors.

Having described the structure and arrangement of my invention, its manner of operation will now be set forth in some detail.

In Fig. 1 is shown a schematic disclosure of the equipment at the originating office of an automatic telephone system of the so-called step-by-step type wherein switching selectors shown in the figure as line finder LF, first selector, second selector, etc. up to and including the ticketing trunk are usually settable directly in response to dial pulses from an originating station. In telephone connections involving the necessity of identifying the number of the calling station such as, for instance, long distance connections, the line may be routed through a third selector which is selectively positioned for connection with a ticketing trunk. If, therefore, the switching train reaches the third selector switch and this switch selectively connects itself to a ticketing trunk reserved for calls necessitating the verification of the calling line number, the calling line identification circuit of the present invention may be used to determine such number by operating relay CONN by any suitable means.

We may now assume that station 8190 initiates a call which requires line identification. When the trunk selectors have been selectively positioned to engage a ticketing trunk over the third selector bank, relay CONN is operated and is followed by the operation of relay ST whose circuit may be completed over a set of contacts on relay CONN and controlled in any other manner desired. A positive source of potential is now connected to the ring conductor of the extended connection over a circuit which may be traced from positive battery on the contacts of relay CK, upper contacts of relay ST, right inner contacts of relay CONN, conductor 201, the ring conductor R of the extended connection, conductor 107, resistance 102, resistance 101 to the anode of tube B. At the same time another path is closed from battery on the contacts of relay CK, lower contacts of relay ST, conductor 305 to the windings of all the register relays, preparing them for operation in the manner described hereinafter. Further, the grounded side of the battery on the contacts of relay CK is now applied through the upper back contacts of relay TP, conductor 401, contact b on relay CONN, terminal marked b, to the cathode of all line tubes whose respective stations are known as ring stations or as individual lines. Since it is assumed that the calling line is a ring station, the connection of positive battery to the ring of the calling line through its extended connection with the ticketing trunk and the negative side of said battery connected to its cathode over contacts b of relay CONN, will cause the tube of the calling line to break down

and be rendered conducting between the cathode and the anode thereof which, as soon as it occurs, will cause conductivity to spread between the cathode and all of the control electrodes in the tube, each of which is now connected to a register relay having positive battery connected therethrough over conductor 305 as above described. In consequence of this conductivity over the control electrodes, circuits are completed thereover to such register relays. Thus over control electrode 1 a path is completed from ground on the cathode, electrode 1, terminal J on punching PTY, contacts on relay CONN, conductor 306, left winding of relay J to battery on conductor 305. Relay J operates and locks over its right winding and right inner contacts, conductor 307, to ground on the contacts of relay 416 in the printer 406. Similar circuits are closed over appropriate electrodes for relay TH8, for relays H1, T9, and U0 all of which operate and lock over their respective right windings and inner contacts to ground on the contacts of relay 416. A circuit is also closed for the appropriate class relay which, in this case may be assumed to be relay C9, over the No. 6 electrode, and another circuit is closed for the appropriate office relay, in this case assumed to be OF9, over the No. 7 electrode, which relays lock over their respective right windings and right inner contacts to ground on conductor 307. Hence the application of breakdown potential over the appropriate conductor of the calling line as extended thereto via the built-up connection, results in the operation and locking of a relay in each of the individual registers which identifies the particular digit or character for which that register is reserved.

As soon as a relay in each register is operated, a series circuit is completed for relay CK extending from battery through its winding, the right outer contacts of office relay OF9, serially through the right outer contacts of the class relay C9, and serially through the right outer contacts of each of the other relays in the individual registers which have been operated, to ground over conductor 308 and the right outer contacts of relay J of the class register. Relay CK operates and disconnects battery from the ring conductor R of the line and from the register relays, causing the tube to quench and the relays to restore to normal, concurrent operations having taken place in the meanwhile to record the station or line number.

If the calling line happened to be station 1098, assumed to be the tip party station by virtue of the fact that its ringer is connected to ground, this fact is transmitted to the identifier over a circuit completed from ground through the station ringer, conductor T of the extended connection, conductor 202, middle right contacts of relay CONN, winding of relay TP to battery. Relay TP operates and applies ground to conductor 402 instead of conductor 401, and thereover, to the cathode of tube A individual to station 1098, such a path tracing from ground on the front contacts of relay TP, conductor 402, contacts a of relay CONN, terminal a of the punching, the cathode of tube A individual to station 1098, and, of course, to the cathodes of all other tubes having their respective cathodes wired to terminal a. Should the loop be long and a relay TP like that shown is too insensitive to operate on the diminished current, a more sensitive single armature and contact relay may be used and another relay operating off said contacts may then be utilized to perform the local functions.

Tube A, however, is the only tube that breaks down and is rendered conducting thereby since the positive potential is applied over the extended connection of the calling station only to its own main anode and to the anode of no other tube. The conductive path is initially through its cathode and anode but almost immediately the conductivity is extended to the control anodes thereof. As with station 8190, circuits are completed between the control electrodes of tube A and over the contacts of relay CONN to the various register relays, operating those which identify the various digits or characters of the calling line as explained with reference to said station 8190.

Returning now to the operation of the register, it is evident that any settable device adapted to respond to the grounds applied to the conductors which connect with signaling conductors 300-304 for registration or recording purposes may be utilized to provide a visual display or record designation of the calling number. In the description of the invention herein given, merely by way of illustrating its operation, it is assumed that a permanent record of the calling line number is desired and that this record is to be a printed one which can be produced by any commercially available printer such as, for instance, the one indicated by the rectangle 406. Those relays of the register which have operated apply ground to the common conductor 309 which connects with the winding of the start relay ST in the progress circuit and causes this relay to operate and start operation of said progress circuit, which may be of any suitable design, to complete circuits (not shown), whereby relays PT, TH, H, T, U, CL and OFF are operated in the order given and whereby the succeeding relay is not operated until the preceding one is released, and whereby the interval during which each of said relays is maintained in an operating position is sufficient to cause the performance of the registering or recording functions indicated below.

When, therefore, relay PT operates, in preparation to record the party designation, an obvious circuit is closed for start relay 415 in the printer 406. Relay 415 operates to prepare said printer to receive the signal grounds applied to the signaling conductors 301, 302 and 304 by the operated relay W or J of the party register circuit, which grounds cause the operation of two corresponding printer magnets to record the party designation. Following the release of relay PT by the progress circuit, the start relay 415 also releases to restore the printer. Upon the operation of relay TH, the five signaling conductors 300-304 are connected to the relays of the thousands register and another obvious circuit is completed for start relay 415, whereupon the printer is caused to repeat the above operation for printing the thousands digit 8 in response to ground upon the conductors grounded by relay TH8 of the thousands register. Similar printing operations are performed upon the operation of relays T, U, CL and OFF, whereby the hundreds digit 1, the tens digit 9, the units digit 0, the class digit 9 and the office digit 2 are printed in response to ground applied selectively to the conductors 300-304 by the tens, units, class and office registers.

When the entire number has been printed, relay 416 is operated in the printer, whereupon locking ground is removed from the relays locked in the registers, causing said relays to release and restore the registers to normal.

It is, of course, obvious that instead of using a progress circuit by means of which the group of signaling conductors for each of the registers is switched into the printer circuit, the progress circuit can be entirely dispensed with by running each group of conductors separately into the printer wherein means may be provided by which the various groups of conductors are cyclically connected to the printer magnets to print or perforate the numbers indicated thereon.

When the registering functions are completed, relay CONN is released, causing thereby the release of relay ST. The release of the register relays in response to the operation of relay 416 restores the operated register relays.

While I have described the principle of my invention in connection with its specific application to a particular telephone system and to a specific kind of gas-filled device, it is to be understood that various other applications and embodiments thereof may be made by those skilled in the art without departing from the spirit of the invention as defined within the scope of the appended claims.

What is claimed is:

1. A line identification circuit for a telephone line having a numerical designation, comprising an electronic device individual to said line, means for activating said device, and means responsive to the activation of said device for registering the numerical designation of said line.

2. A line identification circuit for a telephone line having a multicharacter designation, comprising a gas-filled electronic device having a plurality of electrodes, one for each character of the designation, an anode connected to said line and a cathode, means responsive to said line initiating a call for rendering said gas-filled device conducting between its cathode and anode, means connected to each of said plurality of electrodes and responsive to the conductivity of the cathode and anode of said device for registering the multicharacter designation of said calling line.

3. A line identification circuit for a telephone line having a multicharacter designation consisting of a numerical identification, class of service identification and an office identification, comprising a gas-filled electronic device having a plurality of electrodes each corresponding to an element in said identification, an anode connected to said line and a cathode connected to one terminal of a source of potential, means responsive to said line initiating a call for connecting the other terminal of said source of potential to said anode over said line whereby said gas-filled device is rendered conducting between its cathode and anode and circuit means including sources of potential connected to said plurality of electrodes for registering the multicharacter designations of said line, said circuit means being rendered effective by the conductivity of said gas filled device over said plurality of electrodes subsequent to its initial conductivity between the cathode and anode.

4. An identification circuit for the lines of a telephone system comprising in combination a gas-filled electronic device for each line and a settable register common to all of said lines whereby a potential applied to any one of said lines operates its associated electronic device to set said settable register in accordance with the identity of said line.

5. An identification circuit for the lines of a telephone system comprising in combination a

gas-filled electronic device for each line, a settable register common to all of said lines whereby a potential applied to any one of said lines operates its associated electronic device to set said settable register in accordance with the identity of said line, and means responsive to the setting of said register for disabling said operated gas-filled electronic device.

6. A line identification circuit for the two-party lines of a telephone system, each of said lines having a multicharacter designation which includes the party designation, comprising a gas-filled electronic device having a plurality of

electrodes, one for each character of the designation, the anode of said tube being connected to a conductor of the line, means responsive to said line initiating a call for applying a potential between said cathode and anode for rendering said gas-filled device conducting therebetween, and means including a source of potential connected to said plurality of electrodes for rendering said gas-filled device conducting between its cathode and said plurality of electrodes whereby said means are operated to register the plural character designation of said line.

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