

May 2, 1944.

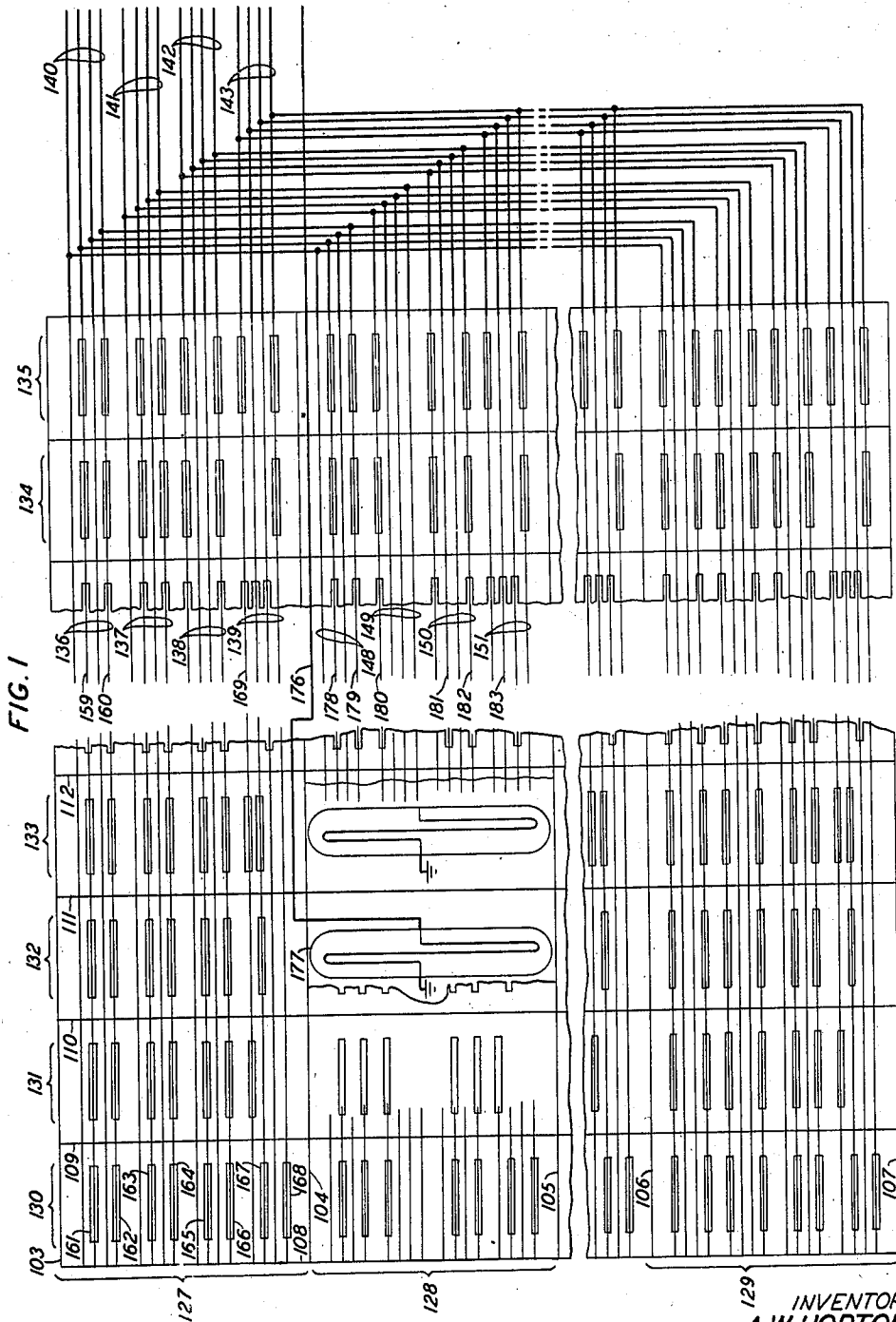
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2,348,131

ELECTRIC SIGNALING

Filed June 27, 1942

4 Sheets-Sheet 1



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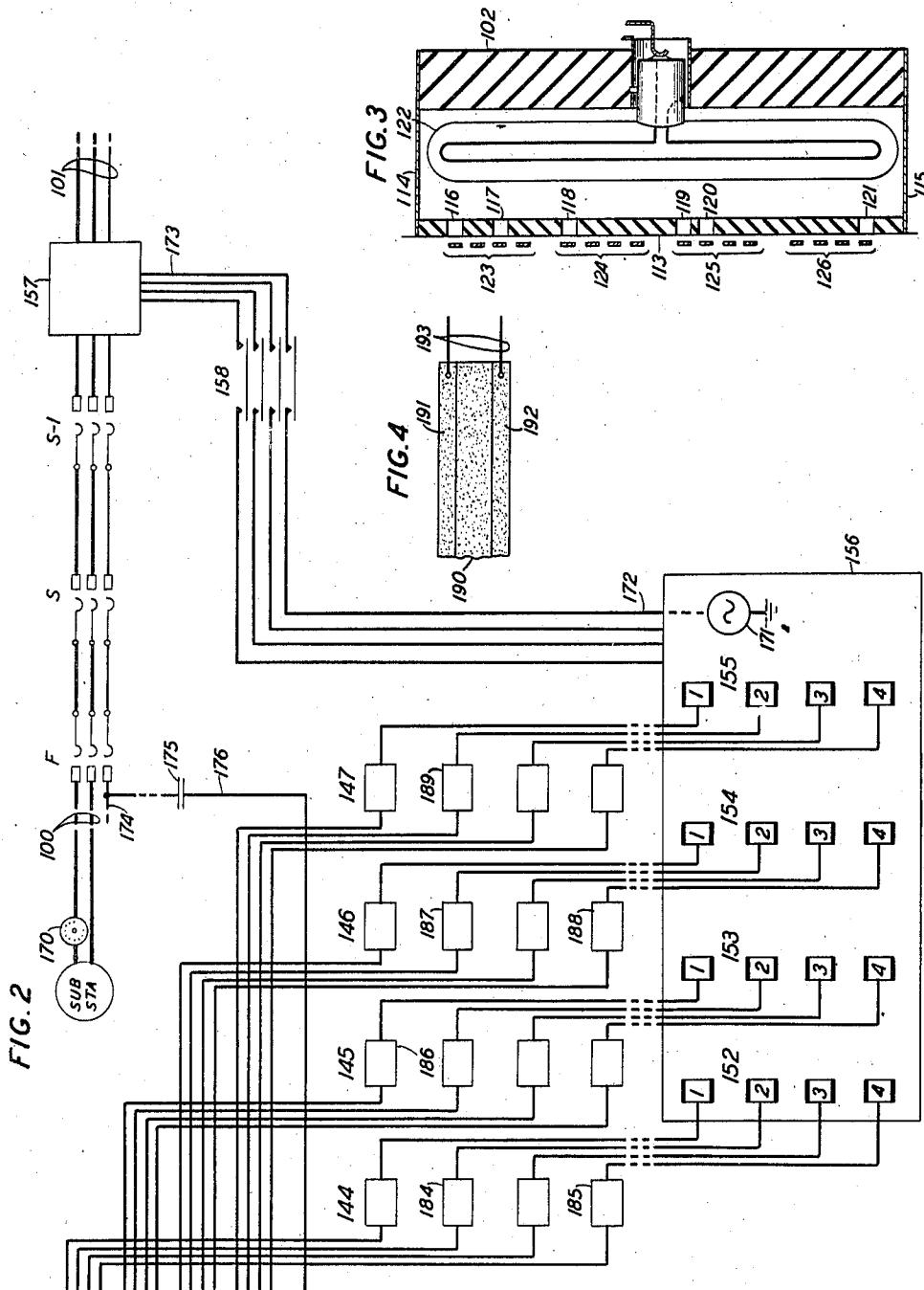
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4 Sheets-Sheet 2



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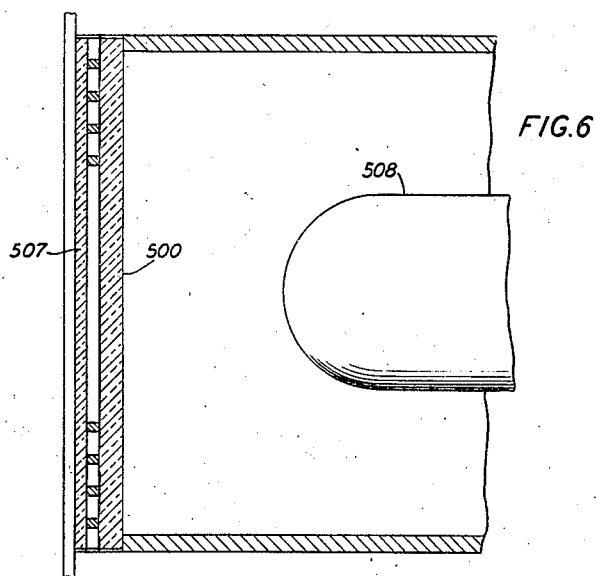
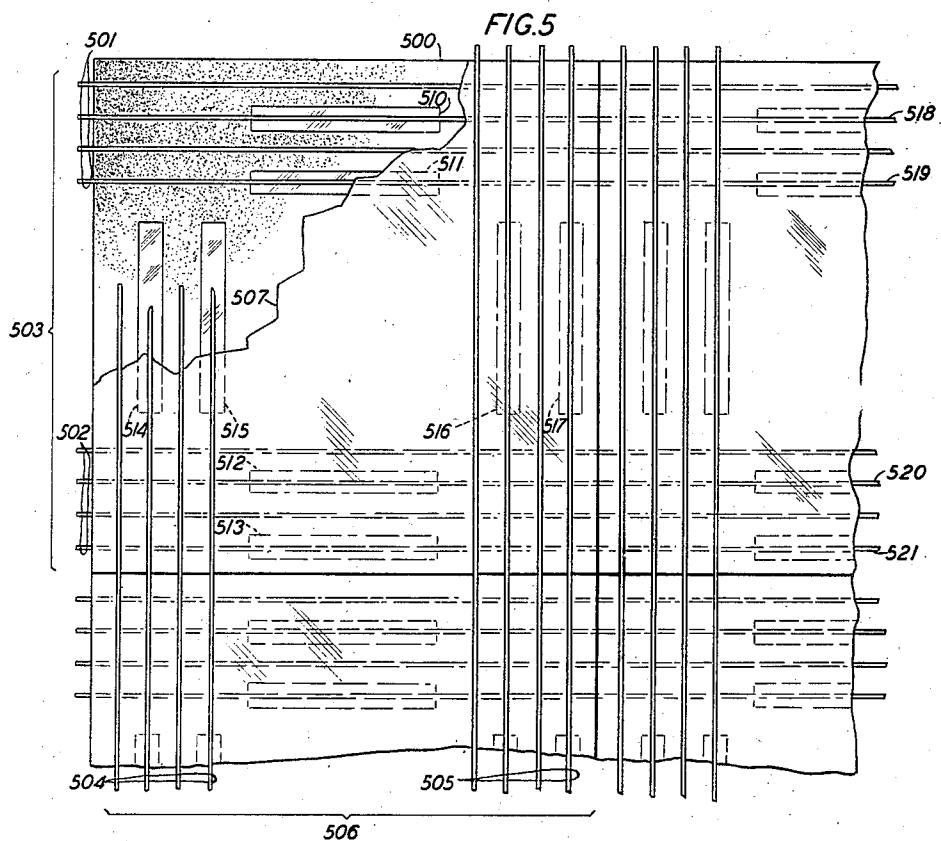
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4 Sheets-Sheet 3



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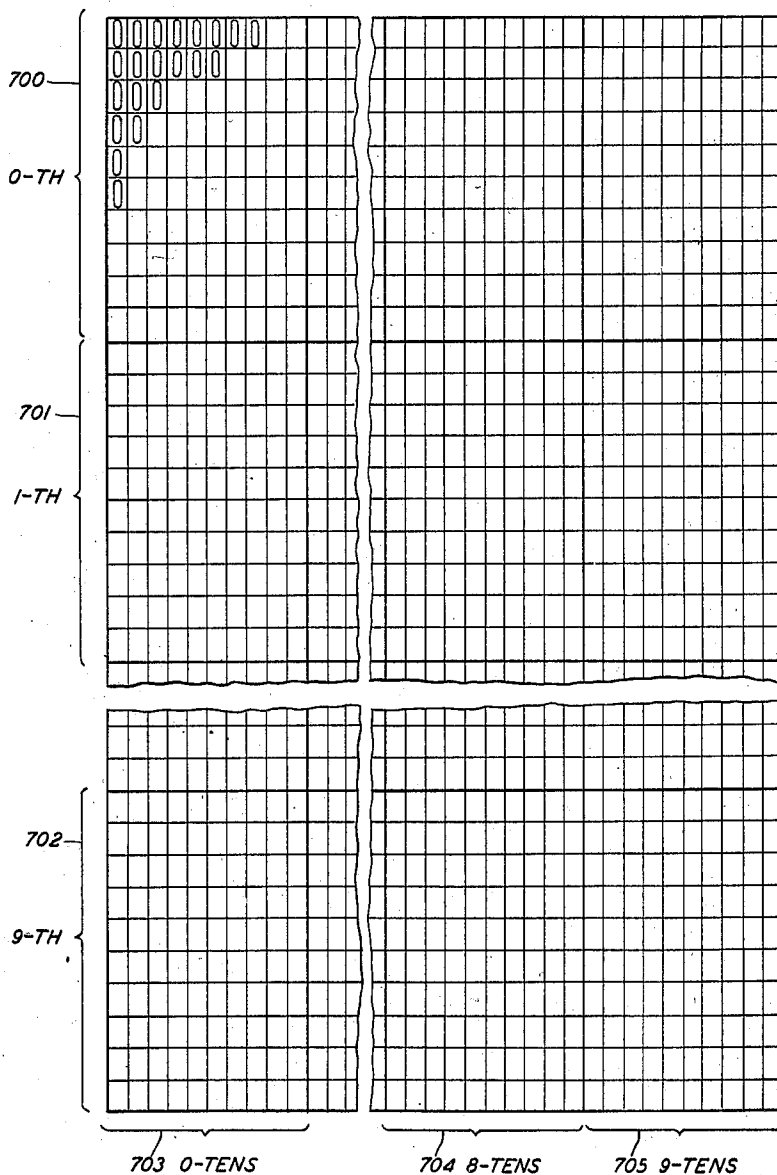
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4 Sheets-Sheet 4

FIG. 7



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2,348,131

ELECTRIC SIGNALING

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Application June 27, 1942, Serial No. 448,732

6 Claims. (Cl. 179-27)

This invention relates to electric signaling, particularly when employed in connection with the operation of automatic telephone systems.

The objects of the invention are to obtain greater economy and simplicity than heretofore realized in the mechanisms used for identifying the lines, trunks, or other electric circuits of a large group; to enable the use of photoelectric devices for effecting the identification and at the same time to reduce to a minimum the amount of associated amplifying equipment necessary; and to effect other improvements in systems of this general character.

The foregoing objects of the invention are realized in a system in which the lines of a group are identified and their designations determined by means in a field or array of signal lamps and light sensitive elements which serve to energize sets of light sensitive elements in code combinations representing the line numbers or designations and in which the light sensitive elements cause the operation of indicating or registering means. More specifically, the signal lamps, which represent individually the specific lines of the group, such as the ten thousand lines in a telephone office, are arranged on a decimal basis in a field of coordinate rows, and a plurality of sets of light sensitive elements, preferably in the form of continuous strips, are provided for each row of lamps and are secured to the structure in proximity to the lamps so that any lamp in the row is capable of projecting its light onto all strips of the several sets pertaining to such row. The several sets of light sensitive strips opposite each row of lamps represent respectively the digital places in the designations of the telephone lines. That is to say, if there are ten thousand lines, each having a four-place designation, four sets of light sensitive strips are provided for each row of lamps. Each set of light sensitive strips contains fewer strips than there are character values for the corresponding digit, and the digit values represented by each lamp are translated to the light sensitive sets by exposing the strips of each set to the lamp in combinations representing a selected code. The desired choice of strips to produce the code for each line is obtained by introducing a screen between the lamps in each row and the associated light sensitive strips. This screen is so designed that it permits light to shine from the illuminated lamps to the particular strips in each of the several sets in accordance with the code for the associated number, whereas all other strips are masked so as not to be affected by the lamp.

The light sensitive strips of the corresponding sets in all rows are multiplied and are connected through suitable amplifying means to code registers, of which there is one for each digital place in the designation. If, as assumed, the line designations have four digital places and a four-unit code is used, there would be four registers each comprising four relays.

An advantage of this system is that the identification of any one of a large number of lines may be obtained by the use of simple photoelectric means which is capable of translating the decimal designations of the lines into a simple code which can readily serve its intended purpose in an automatic telephone system. By reducing the decimal designations of the lines to a code comprising a relatively small number of elements, the amount of amplifying equipment usually necessary where photoelectric devices are employed is correspondingly reduced to a minimum.

A feature of the invention is an identifying system in which some of the strip sets, such as the thousands and hundreds sets, are arranged along the horizontal rows of lamps, and others, such as the tens and units sets, are arranged along the vertical rows of lamps. At each lamp position a transparent plate interposed between the lamp and the photosensitive strips is provided with an opaque covering over all areas except those determining the desired code for each of the four sets of strips, and the overlapping strips are insulated from each other by a thin film of transparent insulating material to prevent the formation of false current paths. More specifically, the intermediate transparent plate is darkened uniformly at all lamp positions in those areas where the horizontal and vertical strips cross each other. In those areas where the light from any particular lamp is capable of reaching the four different sets of strips individually the opaque material is applied opposite the necessary individual strips in each set to give the required codes for that lamp position.

These and other features of the invention will be described more fully in the following detailed specification.

In the drawings accompanying the specification:

Figs. 1 and 2 comprise a conventional diagram illustrating an automatic telephone system arranged for calling line identification;

Fig. 3 is an enlarged cross-sectional detail of the identification panel illustrated in Fig. 1;

Fig. 4 is an enlarged detail of one of the light sensitive strips;

Fig. 5 shows an alternative form of the identification lamp panel;

Fig. 6 is an enlarged cross-sectional detail of the panel shown in Fig. 5; and

Fig. 7 is a diagram of the lamp panel illustrating the numbering arrangement.

The present invention is particularly useful in systems that require the preparation of tickets for the purpose of assessing calling telephone subscribers for the conversations held with other subscribers. Since these tickets are prepared automatically, it is necessary to determine the number of the calling line in order that the charge may be assessed against the proper party. However, the invention may be used in any type of system where it is desirable to determine automatically the identity of a line, trunk, circuit or other device. For example, it is often desirable to display the number of a calling party before an operator to whom the line has been extended, thereby eliminating the necessity for the operator to make an oral request or to perform a number-checking operation.

Referring to Figs. 1 and 2, the automatic telephone system illustrated herein comprises a large group of lines, usually ten thousand, which appear in the central office in non-numerical switches, such as finder switches. The line 100 illustrated in the drawings appears in the bank of line finder switch F which in turn is associated with the first selector switch S. The selector S may have direct access to outgoing trunks or, as shown in the drawings, it may have access through a succeeding selector S-1 to these outgoing trunks, such as the trunk 101, outgoing to distant offices.

The designation or identity of each line that establishes a toll call over one of the outgoing trunks 101 is obtained by the field or panel of signal lamps shown in Fig. 1. This lamp panel includes a lamp for each of the ten thousand lines in the office and each lamp represents the number of the associated line. The lamps are arranged in decimal order in coordinate horizontal and vertical rows, there being one hundred horizontal rows and one hundred vertical rows, each row in both directions containing one hundred lamps.

Referring for the moment to Fig. 7, which illustrates the lamp formation more clearly, the hundred horizontal rows are divided into ten equal groups, one for each thousand lines. For example, the horizontal group of lamps 700 represents the No. 0 thousands group of lines, the horizontal group of lamps 701 represents the No. 1 thousands group of lines, the horizontal group 702 represents the No. 9 thousands group of lines, and similarly for the remaining groups which have been omitted in the drawings. Each of these thousands groups contains ten horizontal rows of one hundred lamps representing the ten hundreds groups in the thousand. In like manner the field of lamps is divided into ten vertical groups representing the ten tens group of all hundreds groups. For example, vertical groups 703, 704 and 705 represent respectively the No. 0, No. 8 and No. 9 tens groups. Each of these tens groups contains ten vertical rows of lamps representing respectively the ten units designations.

The identifying lamp field structure shown in Figs. 1 and 3 comprises a back panel 102 on which the ten thousand lamps are mounted in

one hundred horizontal rows and one hundred vertical rows. These lamps are located in individual chambers formed by a series of horizontal shields or separators 103, 104, 105, 106, 107 and a series of intersecting vertical separators 108, 109, 110, 111, 112, etc. The lamp chambers formed by these intersecting shields may be covered on the front by a single plate, or, as illustrated in Fig. 3, by individual plates 113 closing the area between the horizontal shields 114 and 115 and the corresponding vertical shields. The plates or screens 113 at the various lamp positions are provided with slots or windows 116, 117, 118, 119, 120, 121, located in accordance with the desired code, to permit the emission of light from the associated lamp, such as lamp 122. Arranged across the front of the plates 113 in horizontal rows are four sets of photosensitive strips 123, 124, 125 and 126. These four sets represent the four digital places of the designations, and each set contains four strips which, when taken in different code combinations, furnish the ten different values of the digit. These photosensitive strips are seen in cross-section in Fig. 3, some of them occurring adjacent the light emitting windows and others occurring adjacent the solid portions of plate 113. Each one of these strips (see Fig. 4) comprises a backing 190 of some material, such as cloth, having conducting ribbons 191 and 192 affixed to the edges thereof and a layer of photosensitive substance such as selenium covering the surface between the conducting ribbons. Light shining on the photosensitive substance causes a current or voltage change in the electrical circuit 193 connected to the conducting ribbons which may be utilized in the manner disclosed more fully hereinafter.

Referring particularly to Fig. 1, the first one hundred horizontal rows of lamp positions 127, 128, etc., constitute the ten hundreds in the No. 0 thousand. Similarly, the succeeding horizontal rows of lamp positions, including the last row 129, constitute the hundreds groups of the remaining thousands groups. In the horizontal direction of the panel the first ten vertical rows of lamp positions 130, 131, 132, 133, etc., constitute the ten different units values of the No. 0 tens digit. Similarly, the succeeding vertical rows, including the last two rows 134 and 135, constitute the units values of the remaining tens digits. This, of course, is the same decimal arrangement of the lamps as the one illustrated in the diagram of Fig. 7. The four sets of photosensitive strips 136, 137, 138, 139, serving the horizontal row 127 are arranged as illustrated across the front of the plates 113. These strips, which are illustrated in Fig. 1 by single lines, are connected by conductors 140, 141, 142, 143 to four groups of individual amplifiers 144, 145, 146, 147. The four sets of photoelectric strips 148, 149, 150, 151 serving the second horizontal row of lamps 128 are similarly arranged across the front of the area and are multiplied respectively to the conductor groups 140, 141, 142, 143. In like manner each of the remaining horizontal groups of lines in the area is provided with similar sets of photoelectric strips, and these strips are all multiplied to the conductors 140, 141, 142 and 143 leading to the amplifiers 144, 145, 146 and 147. The output circuits lead, through a connecting medium if desired, to the four sets of registers 152, 153, 154 and 155 in the registering mechanism 156. The registering mechanism 156 is in turn connectable to the

control relay circuit 157 of the trunk 101 through a connector 158.

The number of any line in the office, which is represented by a particular lamp in the array, is determined by energizing the sets of photoelectric strips in a selected code by the light shining from the lamp. While any desired code may be used, the one given in the following table has been chosen for illustration in the drawings.

Digit	Register relays
0.....	2 and 4.
1.....	1.
2.....	2.
3.....	1 and 2.
4.....	3.
5.....	1 and 3.
6.....	2 and 3.
7.....	1, 2 and 3.
8.....	4.
9.....	1 and 4.

To cause the operation of the register relays 152, 153, 154 and 155 in accordance with the code above given, the screens 113 before the various lamp positions are provided with windows correspondingly located with respect to the photoelectric strips of the four different sets. For example, the lamp located in the position at the intersection of horizontal row 127 and vertical row 130, namely, in the upper left-hand corner of Fig. 1, represents line number 0000. In other words, this line is in the No. 0 thousands group, in the No. 0 hundred of the thousand, in the No. 0 tens group of the hundred, and in the No. 0 units position in the group of ten. Accordingly, to register the designation of this line it is necessary to energize relays 2 and 4 in each of the thousands, hundreds, tens and units registers 152, 153, 154 and 155. Therefore, the plate 113 in front of the lamp is provided with windows opposite the second and fourth strips 159 and 160 of the thousands set 136 and also opposite the second and fourth strips of each of the hundreds, tens and units sets 137, 138 and 139. Thus, when the lamp is illuminated, light therefrom shines through the windows 161, 162, 163, 164, 165, 166, 167 and 168 to energize the associated strips, whereas the other two strips in each of the four sets remain unaffected. When line number 0001 is involved, the associated lamp located at the intersection of horizontal row 127 and vertical row 131 is illuminated, and light shines on the second and fourth strips in each of the thousands, hundreds and tens sets 136, 137 and 138 and on the first strip 169 in the units set 139. Consequently the No. 2 and No. 4 relays of registers 152, 153 and 154 and the No. 1 relay of register 155 are operated. And it will be found that the location of the light windows before all other lamps in the area corresponds with the desired code.

A description will now be given of the operation involved in the process of identifying a subscriber's line. Assume for this purpose that the subscriber of line 100 desires to make a toll call for which a ticket should be prepared to record the nature of the call and the charge therefor. When the subscriber initiates the call, the line finder F finds his line and extends it to the usual pulsing mechanism associated with the first selector switch S. The switch S and the switch S-1 respond to successive series of impulses transmitted by the subscriber's dial 170 to extend his line to an idle trunk 101 outgoing in the desired direction. At any suitable time during the extension of the connection of the sub-

scriber's line to the trunk 101 an idle registering mechanism 156 is associated with the trunk 101 by means of a connecting device 158. The subscriber continues to dial the remaining digits 5 of the wanted designation, and these digits may, if desired, be registered in the mechanism 156 where they are later used to control the operation of the switches in the offices beyond and also to furnish the required information for 10 printing the designation of the called subscriber's line.

As soon as the mechanism 156 is ready to receive the identification of the calling line 100, it establishes connection with the identifying 15 lamp equipment through suitable connectors provided for that purpose. Also a circuit is closed from the source of energy 171 over conductors 172, connector 158, conductor 173, thence over the sleeve connection through switches S-1, S 20 and F to the sleeve conductor 174 of the subscriber's line 100. The circuit is completed from conductor 174 through the condenser 175, conductor 176 through the filament of lamp 177 to ground. It will be seen from the position occupied by the lamp 177 in the area that the designation of the line 100 is "0102." Accordingly the code windows before this lamp permit light to shine on strips 178 and 179 in set 148, on strip 180 in set 149, on strips 181 and 182 in set 150, 25 and strip 183 of set 151. The current flowing in the circuits connected to the energized strips is amplified by amplifiers 184, 185, 186, 187, 188 and 189 and is then applied to the registers, causing the operation of the No. 2 and No. 4 30 relays of register 152, the No. 1 relay of register 153, the No. 2 and No. 4 relays of register 154 and the No. 2 relay of register 155. Any suitable means may be provided in the mechanism 156 for transferring the information on the registers to the controlling circuits 157 where it 35 serves to operate a ticket printer to print the number of a subscriber's line together with other information about the call. After all the necessary operations have been performed, the registering mechanism 156 is disconnected from the 40 identifying lamp equipment and from the controlling circuits 157.

The mechanism 156 corresponds in its purposes and operation and, if desirable, may also 50 correspond in large measure with the structure of the register-sender and identifying mechanisms fully disclosed and described in Gooderham 2,300,829 of November 3, 1942, and in the application of Gooderham, Serial No. 448,782 filed June 27, 1942. The thousands, hundreds, tens, and units 55 digits of the calling number are registered on registers 152, 153, 154 and 155 as above described, and these registers then control the ticket printing apparatus associated with control circuits 157. Also the control mechanism 157 individual to 60 trunk 101 may be the same in structure and in operation as the corresponding mechanism fully shown and described in the Gooderham patent and application. Reference is, therefore, made to this patent and application for a full understanding of the manner in which the mechanism 156 is seized in response to the dialing by the 65 calling subscriber and connected to the ticketing trunk 101 through the connector 158, of the manner in which the digits of the called line are registered in mechanism 156, of the manner in which the tone current is sent from source 171 over the sleeve of the connection to cause the identifying circuits to identify the particular 70 line calling and to register the digits of the num-

ber of this line in the mechanism 156, of the manner in which the printer and trunk controlling mechanism 157 operates, and of the manner in which these identification systems operate in any other respect that may be helpful to an understanding of the application of the present invention.

In the alternative identifying lamp structure illustrated in the enlarged details of Figs. 5 and 6, the front of the lamp chambers of the entire area is covered with a plate 500 of transparent material such as glass. The four sets of photosensitive strips are then mounted on the glass plate 500 in a manner somewhat different from that illustrated in Figs. 1 and 3. Instead of arranging all four sets in parallel along the horizontal row of lamps, two of these sets are arranged horizontally, and the other two are arranged vertically. That is to say, the thousands set of strips 501 and the hundreds set 502 are disposed along the horizontal row 503 of one hundred lamp positions; and the tens set 504 and the units set 505 are disposed along the vertical row 506 of one hundred lamp positions. As best seen in Fig. 6 the horizontal sets of strips are mounted directly on the surface of the glass plate 500 and are separated from the vertical sets of strips by means of a thin plate of transparent insulating material 507, which may also be of glass. The light from the lamp 508 at each position is directed to the four sets of strips in accordance with the proper code by means of a mask applied to the surface of the plate 500. This mask may comprise a coat of black paint or any other suitable substance applied to all areas of the plate 500 except those through which it is desired to have the light shine upon the photosensitive strips. This is illustrated in the figures in which it will be noted that the position occupied by lamp 508 at the intersection of the horizontal row 503 and the vertical row 506 corresponds to line 0000. The code of this number is obtained by applying the opaque coating to the entire surface of the plate 500 in front of the lamp except the areas 510 and 511 of the thousands set, areas 512 and 513 of the hundreds set, areas 514 and 515 of the tens set and areas 516 and 517 of the units set. When, therefore, the signal lamp 508 is illuminated, light shines through the transparent windows 510 and 511 to energize the second and fourth thousands strips 518 and 519, through windows 512 and 513 to energize the second and fourth hundreds strips 520 and 521, and similarly through windows 514 and 515 and 516 and 517 to energize the corresponding strips in the tens and units sets 504 and 505.

What is claimed is:

1. In a telephone system in which designations are assigned to the lines of a group on a decimal basis, each designation having a plurality of digital places, the combination of a plurality of signal lamps individual respectively to the lines of said group, said lamps being arranged in decimal order in a field of coordinate rows, a plurality of sets of light-sensitive strips fixed before each row of lamps in one coordinate direction, said sets corresponding respectively to the digital places of the designations, the number of strips in each set being less than the number of possible digit values in the corresponding digital place, a screen interposed between said lamps and said strips and designed to permit the light from each lamp to impinge upon a combination of the strips in each of the associated sets rep-

resenting in code the decimal designation of said lamp and its individual line, means for lighting the lamp of any desired one of said lines to energize the light sensitive strips before such lamps, and means responsive to the combination of energized strips for indicating in code the designation of said desired line.

2. In a signaling system having a group of lines provided with individual designations, each of which has a plurality of digital characters, the combination of a plurality of signal lamps individual respectively to said lines, said lamps being arrayed in a field of coordinate horizontal and vertical rows bearing a definite relation to the values of the designation characters of said lines, a plurality of sets of light sensitive elements affixed before each row of lamps in one of said coordinate directions, each of said elements having an appearance before every lamp in the associated row, said sets of elements corresponding respectively to the digital characters of said designations, a screen interposed between said lamps and said light sensitive elements and designed to permit the light from each lamp to impinge upon a combination of said elements representing the designation characters of said lamp and its individual line, means for lighting the lamp of any desired one of said lines to energize said light sensitive elements, and means responsive to the energized elements for indicating the designation of said desired line.

3. In a signaling system having a group of lines provided with individual designations, each of which has a plurality of digital characters, the combination of a plurality of signal lamps individual respectively to said lines, said lamps being arrayed in a field in a plurality of rows, the order of the individual lamps in said rows bearing a definite relation to the values of the designation characters of said lines, a plurality of sets of light sensitive strips fixed before each row of lamps, each of said strips having an appearance before all lamps in the associated row, conductors for connecting the corresponding strips of all rows in multiple relation, a screen interposed between said lamps and said strips and designed to permit the light from each lamp to shine on a combination of the strips representing the designation of the associated line, means for lighting the lamp of any desired one of said lines to energize the light sensitive strips and to cause current to flow in said conductors, and means responsive to said current flow for indicating the designation of said desired line.

4. In a signaling system having a group of lines provided with individual designations, each of which has a plurality of digital places, the combination of a plurality of signal lamps individual respectively to said lines, said lamps being disposed in a field in a definite relation with respect to the designations of the associated lines, a plurality of light sensitive elements fixed before the lamps in said field, an opaque member disposed between the lamps and said light sensitive elements, said opaque member having windows therein to permit the light from said lamps to shine on said light sensitive elements in combination representing the designations of said lines, and means controlled by the energized light sensitive elements for establishing the designation of any desired one of said lines.

5. In a signaling system having a group of lines provided with individual designations, each of which has a plurality of digital places, the combination of a plurality of signal lamps individual

respectively to said lines, said lamps being disposed in a field of coordinate horizontal and vertical rows, the order of the individual lamps in said field bearing a definite relation to the values of the digital characters in said digital places, shields arranged between said horizontal and vertical rows to form light chambers, one for each lamp, each chamber serving to confine the light from the associated lamp, a plurality of sets of light sensitive elements disposed along each row of lamps in one coordinate direction, each element in each of the sets which serves a particular row having an appearance before all of the lamps in such row, the several sets assigned to each row corresponding respectively to the digital places of the designations of the lamps represented by such row, a light screen covering all of said light chambers and interposed between the lamps and said light sensitive elements, said light screen having windows at each lamp position for admitting light to the light sensitive elements of each associated set in combinations representing the values of the digital characters in the corresponding digital places, means for lighting the lamp representing any desired one of said lines to energize the associated light sensitive elements, and means controlled by said energized elements for establishing the designation of said desired line.

6. In a signaling system, a group of lines pro-

vided with individual designations, each designation having a plurality of digital characters, a plurality of signal lamps individual respectively to said lines, said lamps being arranged in a field of coordinate horizontal and vertical rows and in an order bearing a definite relation to the designation characters of said lines, a plurality of sets of light sensitive elements for each horizontal row of lamps, each of said sets representing one of the digital characters of the designations of the lines represented by the horizontal row, a plurality of sets of light sensitive elements for each of said vertical rows of lamps, each of said latter sets representing respectively one of the digital characters of the designation of the lines represented by the vertical row, a light screen interposed between the lamps of said field and said light sensitive elements, said screen having windows at each lamp position for permitting light to shine on the light sensitive elements of each of the sets serving the corresponding horizontal row and on each of the sets serving the corresponding vertical row in combinations representing the several characters of the designation of the associated line, and means controlled by the energized light sensitive elements for establishing the designation of any desired one of said lines.

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