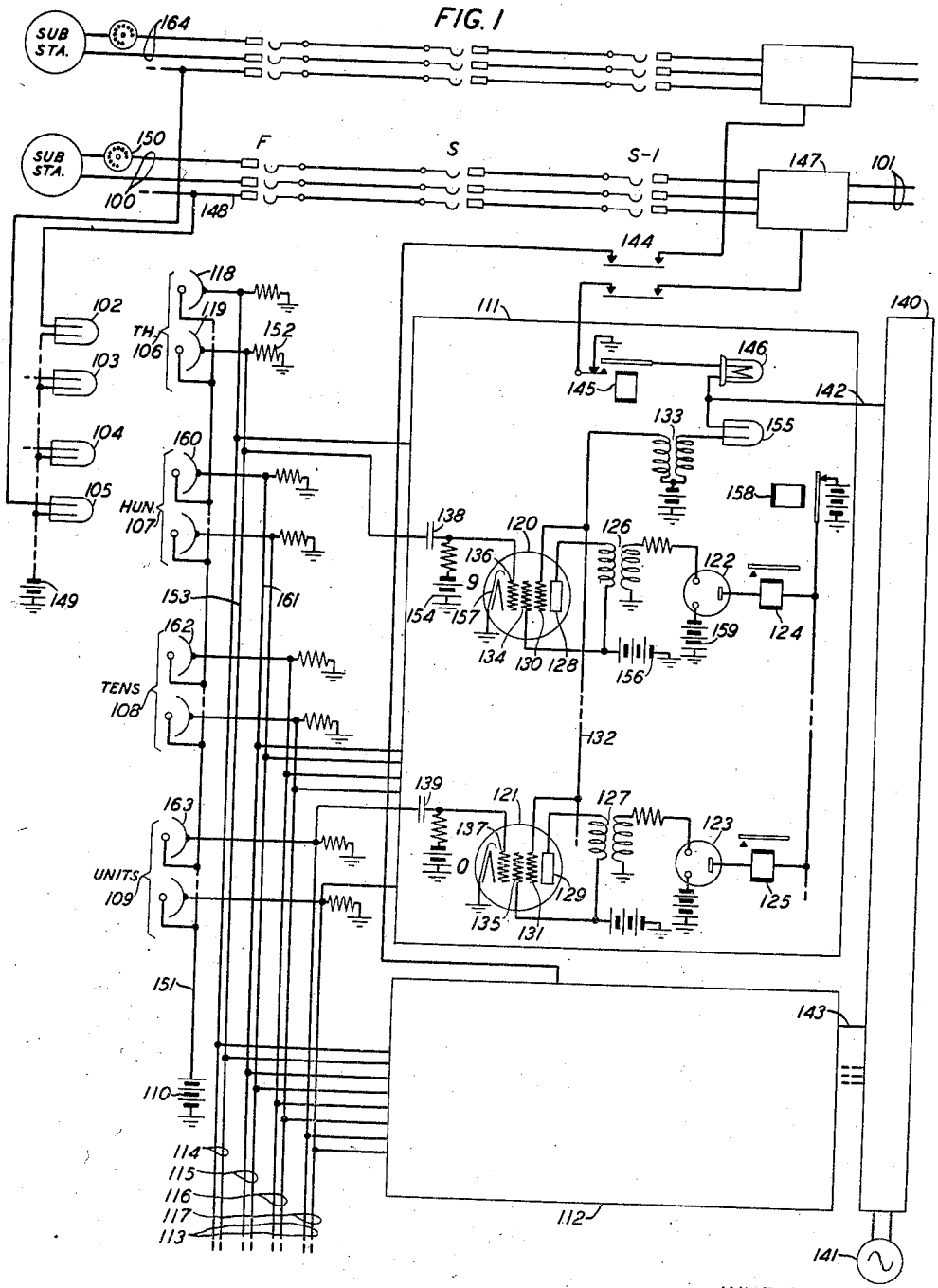
Jan. 4, 1944. W. H. T. HOLDEN 2,338,434

SIGNALING SYSTEM

Filed June 27, 1942 4 Sheets-Sheet 1

FIG. 1



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SIGNALING SYSTEM

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FIG. 2

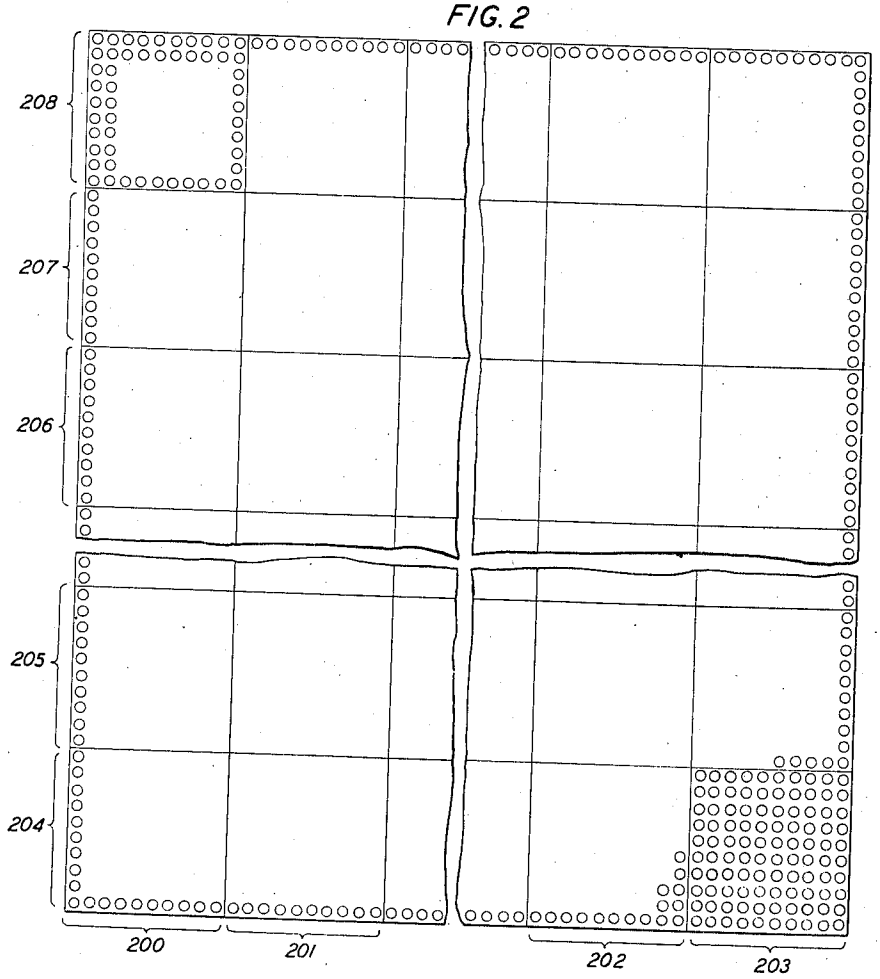
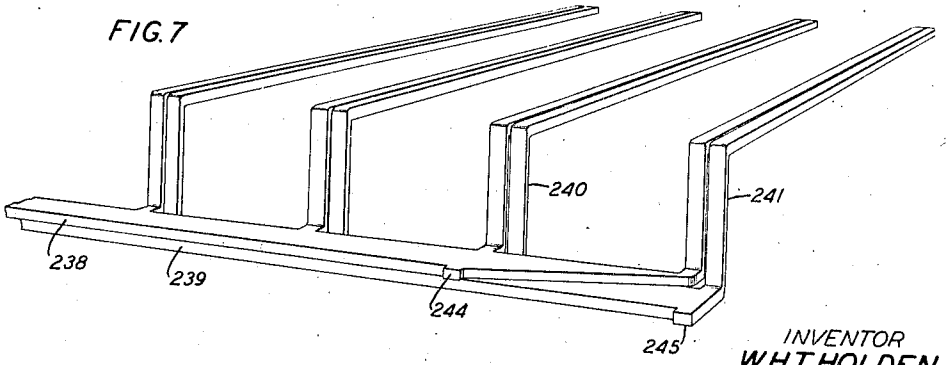


FIG. 7



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SIGNALING SYSTEM

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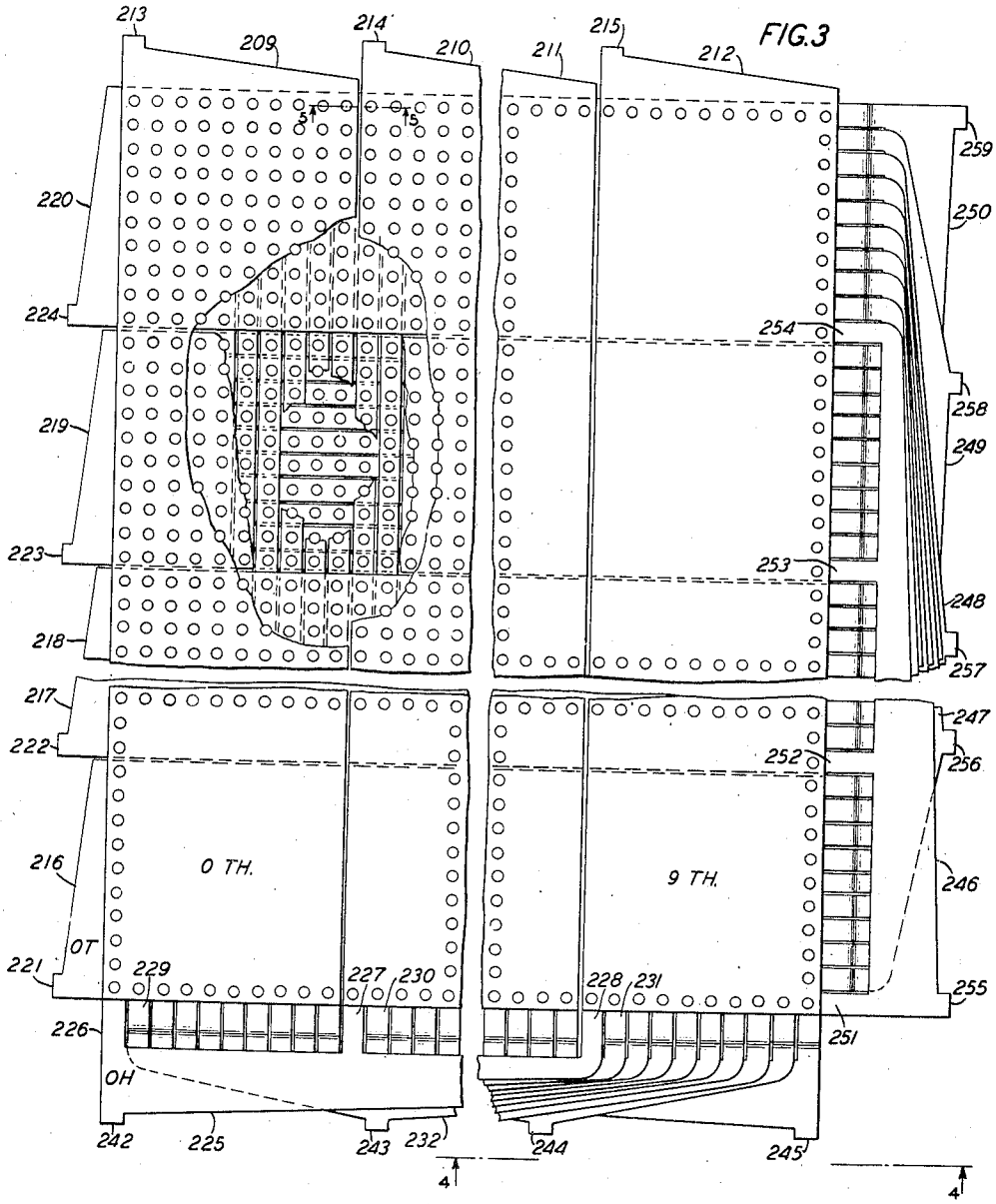
FIG.3



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SIGNALING SYSTEM

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FIG.4

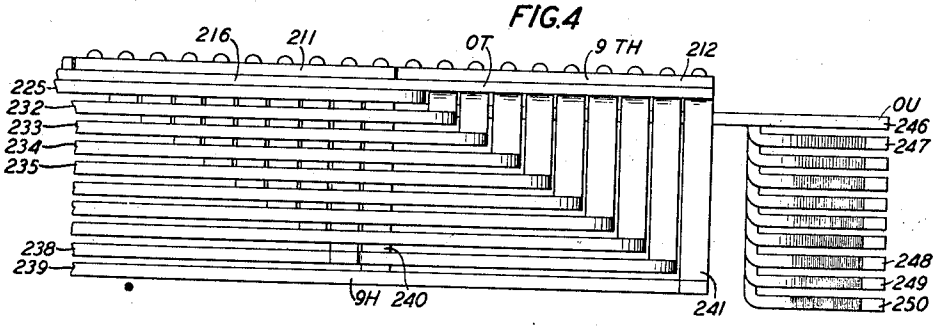


FIG.5

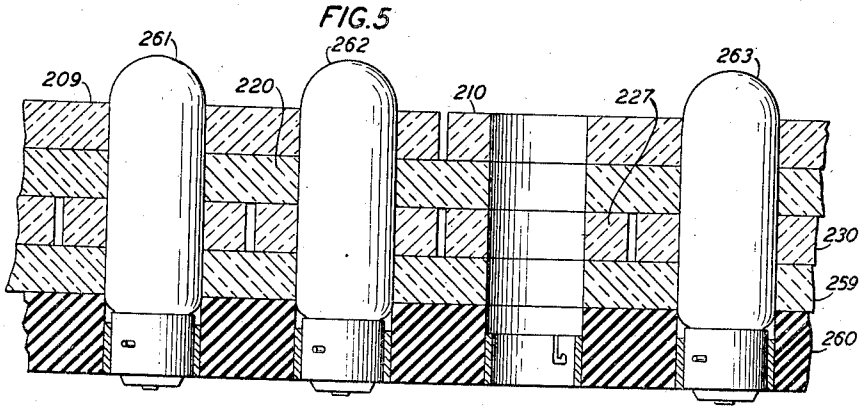
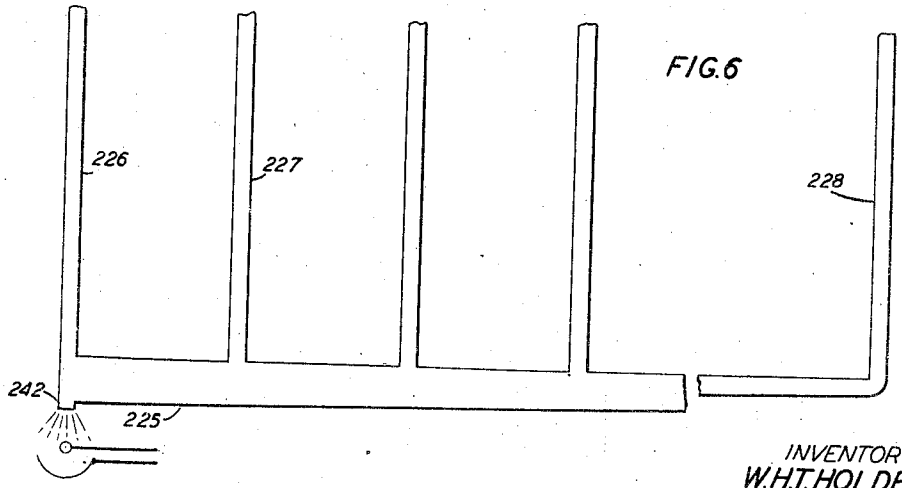


FIG.6



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Patented Jan. 4, 1944 2,338,434

UNITED STATES PATENT OFFICE

2,338,434

SIGNALING SYSTEM

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Application June 27, 1942, Serial No. 448,731

8 Claims. (Cl. 179—27)

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

An object of the invention is to facilitate the identification of lines, trunks, or other electrical circuits or devices.

Another object is to increase the efficiency of the identifying equipment by utilizing a common signaling mechanism for obtaining the identity of a plurality of lines concurrently.

These and other objects of the invention are realized in a system comprising a plurality of identifiers which may be connected concurrently to calling lines in the group, and in which a plurality of signal lamps, one for each of the lines, are arrayed in a definite order with respect to the designations of the lines and serve to energize selectively the photoelectric cells of a group, which in turn operate the connected identifiers to establish therein the digital characters of the associated lines. More specifically, said identifiers are provided with an impulse generator which produces impulses of a plurality of different phases, each phase characterizing a different one of said identifiers, each identifier serving to transmit impulses of its characteristic phase to flash the particular lamp in said array representing the line to which the identifier is connected, the impulses of all phases produced by the photoelectric cell in response to the flashing lamps being delivered to all of said identifiers simultaneously, and each identifier being provided with means selectively operative in response to impulses of its own characteristic phase delivered thereto by the photoelectric cells to establish in said identifier the designation of the calling line connected thereto. The advantage of this identifying arrangement is that the field of signal lamps representing all of the lines in a telephone office may be utilized to identify a plurality of lines that are in a calling condition simultaneously.

A feature of the invention is a system of this character in which the light from the lamps in the common field or array is conducted to the photoelectric cells, which represent the various digital values of all digit places in the line designations, by means of light-conducting elements associated with the lamps in the field in accordance with the digital place values. More specifically plates of light-conducting material are associated in the field of lamps in such a way that the light from the lamps of all lines having the same character value in each digital place of the designations is collected by the associated plate and conducted to the photoelectric cell which also represents the same character value of the same digital place.

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

In the drawings accompanying the specification:

Fig. 1 is a conventional diagram of an automatic telephone system arranged for calling line identification;

Fig. 2 illustrates the field or panel of lamps representing the subscribers' lines in an office and serving to identify the lines by their numbers;

Fig. 3 illustrates the field of lamps together with the associated light transmitting plates for conducting the light from said lamps to the photoelectric devices;

Fig. 4 is an end view of the lamp panel taken along the line 4—4 of Fig. 3;

Fig. 5 is an enlarged sectional view of the lamp panel taken along the line 5—5 of Fig. 3;

Fig. 6 is a plan view of one of the light-conducting plates of the panel assembly; and

Fig. 7 is a perspective view of the light-conducting plates.

The present invention is particularly useful in systems that require the preparation of tickets for the purpose of assessing a calling telephone subscriber for 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 Fig. 1 of the drawings, the automatic telephone system illustrated herein comprises a large group of lines, usually ten thousand, which appear in the telephone central office in non-numerical switches such as finder switches. The line 100, for example, appears in the bank of line finder switch F which in turn is associated with a first selector switch S. The selector S may have direct access to outgoing trunks, or it may have access through a succeeding selector switch S—1 to these outgoing trunks, such as the trunk 101, extending to distant offices.

The designation or identify of each line that establishes a toll call over one of the outgoing trunks **101** is obtained by selectively conducting the light from any lighted lamp in the field to a series of photoelectric cells representing the digital values of the line designation corresponding to the lighted lamp. To this end four sets of light-conducting plates are associated with the field of lamps, said sets representing respectively the four digital places of the line designations.

Before proceeding further with the description of the light-conducting plates, an explanation will be given of the numerical arrangement of the signal lamps in the field. Referring to Fig. 2, the lamp field here illustrated comprises ten thousand signal lamps, one for each subscriber's line in the office. These 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. The hundred vertical rows are divided into ten equal groups, one for each thousand lines. For example, the vertical groups **200**, **201**, **202** and **203** represent the No. 0, No. 1, No. 8 and No. 9 thousands groups of lines, and the six intermediate groups of lamps not shown in the drawings represent the corresponding thousands groups. Each one of these thousands groups contains ten vertical rows of one hundred lamps representing respectively the ten hundreds groups in the thousand. In like manner the field of lamps is divided into ten horizontal groups representing the ten tens groups of all hundreds groups. For example, the horizontal groups **204**, **205**, **206**, **207** and **208** represent respectively the No. 0, No. 1, No. 7, No. 8 and No. 9 tens groups. Each of these tens groups contains ten horizontal rows of lamps representing respectively the ten different values of the units digit.

Returning now to the light-conducting plates associated with the lamp field and referring particularly to Figs. 3 to 7, it will be noted that there are ten of these plates **209**, **210**, **211**, **212** representing the ten different values of the thousands digit. The plate **209**, for example, representing the No. 0 thousand, covers the entire thousands vertical group of lamps **200**. Furthermore, the plate **209** is provided with one thousand holes coordinately arranged coincident with the coordinate arrangement of the lamps in this thousands group. In fact the lamps, when in place, project through the holes in the plate **209** and also through the holes in the associated plates as will be explained hereinafter. The plate **212** covers the lamps in the No. 9 thousands group **203** and is likewise provided with coordinate rows of holes for receiving the lamps in this group. Similarly there are eight intermediate light-conducting plates corresponding to the eight intermediate thousands groups of lamps. The ten thousands plates **209**, **210**, **211** and **212** lie in the same plane and constitute the first layer of the light-conducting plates, as seen more clearly in Figs. 4 and 5. Thus when any lamp in any thousands group is illuminated the light from said lamps enters the associated thousands plate and is conducted by said plate to an exit point where it is caused to shine on an associated photoelectric cell. The ten thousands plates **209**, **210** and **212** are provided with the respective light exit points **213**, **214**, **215**, and all other surfaces of these plates, with the exception of the surfaces in the holes adjacent the signal lamps, are covered with an opaque paint or other substance to prevent the escape of light. In other words, any light entering the medium of the plate from the signal lamp is conducted through the plate and emerges at the exit point. These plates are preferably made of some material having a relatively high light-conducting property.

There are also ten tens light-conducting plates similar in size and shape to the thousands plates but arranged in the assembly at right angles thereto. The No. 0 tens plate **216** covers the No. 0 tens group of lamps **204** (Fig. 2) and contains one thousand holes arranged in coordinate rows and in registration with the corresponding holes in the thousands plates **209**, **210**, etc., for receiving the lamps. The tens plates **217**, **218**, **219** and **220** relate respectively to the No. 1, No. 7, No. 8 and No. 9 tens groups, the intermediate plates not being shown in the drawings. As seen in Figs. 4 and 5 the tens plates occupy the second layer in the assembly. Thus the light from any one of the thousand lamps in a particular tens group is conducted by the associated plate to the light exit point for application to a photoelectric cell. To this end the tens plates are provided with the light exit points **221**, **222**, **223**, **224**.

There are also ten light-conducting plates for the ten different values of the hundreds-place digit. It is necessary, however, to shape these plates like a comb, as seen in Fig. 6, for the reason that each value of the hundreds digit is represented by a row of one thundred lamps in each of the ten thousands groups. More specifically, the hundreds plate **225**, which represents the No. 0 value of the hundreds place digit, has one strip or tooth **226** covering the single row of lamps in the No. 0 thousands, a strip **227** covering the single rows of lamps in the No. 1 thousands, and so on for each of the remaining thousands groups, including the last strip or tooth **228** which covers the single row of lamps in the No. 9 thousand having the No. 0 hundreds digit. The next hundreds plate **232** represents the No. 1 hundreds digit and is therefore provided with ten strips **229**, **230**, **231**, covering respectively the ten vertical rows of lamps in the ten thousands groups having the hundreds digit 1. And likewise the eight remaining horizontal plates **233**, **234**, **235**, **238**, **239** are provided with strips which are similarly disposed with respect to the vertical rows of lamps in the assembly. The hundred teeth or strips **226**, **227**, **228**, **229**, **230**, **231** on the ten hundreds plates are disposed in a single plane in the lamp assembly constituting the third layer as seen in Figs. 4 and 5. To accomplish this arrangement the body and the teeth of the No. 0 hundreds plate **225** all lie in the same plane as seen in Figs. 4 and 6, but the teeth on the remaining nine plates are offset with respect to the bodies of the plates by progressively increasing amounts as best seen in Figs. 4 and 7. For example, the ten strips including the last two, **240** and **241**, on the lowermost or No. 9 plate **239** are first turned up at right angles of the body of the plate and are then turned over again at right angles to permit the perforated sections of these ten strips to occupy a single plane in the lamp assembly. Like the others, the hundreds plates are provided with exit points **242**, **243**, **244**, **245**.

Finally there are ten units plates **246**, **247**, **248**, **249**, **250**, which are shaped like the hundreds plates, each being provided with ten strips or teeth covering the ten horizontal rows of lamps in the field having the same value for the units digit.

For example, the No. 0 units plate 246 is provided with ten teeth 251, 252, 253, 254 which cover respectively the ten horizontal rows of lamps in the ten tens groups having the No. 0 units digit. Like the hundreds plates, the hundred strips of the ten units plates are all disposed in the same plane in the lamp assembly, this plane constituting the fourth layer as seen in Figs. 4 and 5. Also the units plates are provided with exit points 255, 256, 257, 258, 259.

The four layers of plates above described are mounted upon a suitable base of insulating material 260, which also contains the sockets for the thousand signal lamps 261, 262, 263. As above explained, the holes in all of the plates are in registration to receive the lamps, which are suitably shaped for that purpose, and all surfaces of all plates are covered with some opaque material, except the surfaces within the holes which receive the signal lamps. It will now be seen that any illuminated lamp in the array causes its light to enter a combination of four conducting plates, depending upon the location of the lamp, and the light entering these four plates is conducted selectively thereby to the four corresponding exit points. Since these four exit points characterize the four designation digits of the lighted lamp, it is possible to translate these light signals through photoelectric means into currents that may be utilized to register the designation of the associated line. It was mentioned hereinbefore that the light-conducting plates are preferably made of material having high conducting properties; and it will be understood that the conductivity of these plates is so high relative to the conductivity of the signal lamp envelopes that no detrimental effect results from the leakage of light.

The lamp panel assembly shown in detail in Figs. 2 to 7 is provided in the central office of a telephone system, such as the one illustrated in Fig. 1, and includes a signal lamp for each of the ten thousand lines of the office. Four of these signal lamps 102, 103, 104 and 105 have been illustrated in Fig. 1, the remaining lamps and the light-conducting plates being omitted for the sake of simplicity. As will be explained hereinafter, the signal lamps in the lamp panel are designed to illuminate and extinguish in response to rapid impulses applied to them over the operating circuits. Accordingly, these lamps are preferably of the gaseous discharge type, although any type of lamp may be used which is capable of following impulses of the required speeds.

Four sets of photoelecric cells or other light-sensitive devices 106, 107, 108 and 109 are also provided in the central office and are associated with the light-conducting plates in the lamp panel assembly for the purpose of receiving the light selectively conducted from any lighted lamp in the panel. There are, it will be remembered, four sets of these light-conducting plates, each set comprising ten plates and each plate having a single light exit point. Accordingly, the group of photoelectric cells 106 represents the thousands digital place and comprises ten individual cells, one for each of the ten values of the thousands digit. These ten individual cells are located, as illustrated in Fig. 6, respectively in proximity to the exit points of the corresponding plates of the thousands group. Similarly the hundreds group of cells 107 comprises ten separate cells which are located respectively adjacent the light exit points of the ten hundreds light-conducting plates. And the same is true of the ten photoelectric cells 108 of the tens group and of the ten cells 109 of the units group.

The central electrodes of all forty of the photoelectric cells are connected in multiple to the positive pole of battery 110, and the outer electrodes of the forty cells are connected respectively to forty multiple conductors of the group 113 which comprises a connecting medium between the cells and a plurality of number identifiers 111, 112, etc., the multiple medium 113 is divided into four sets of conductors 114, 115, 116 and 117 corresponding to the thousands, hundreds, tens and units places. Accordingly the set 114 includes ten conductors which are connected respectively to the ten photoelectric cells 118, 119 in the group 105. Similarly there are ten conductors in the set 115 which are connected respectively to the ten cells in the hundreds group 107. And in like manner the ten conductors of set 116 and the ten conductors of set 117 are connected respectively to the cells of the tens group 108 and to the cells of the units group 109.

Each of the line identifiers, such as the identifier 111, includes a series of forty space discharge tubes which are connected respectively to the forty conductors of the multiple group 113. Only two of these tubes, tube 120 of the thousands set and tube 121 of the units set, are illustrated, but it will be understood that the remaining thirty-eight tubes are provided and are connected similarly to the appropriate conductors of the multiple group 113. The first ten tubes, including the tube 120, represent the ten values of the thousands digit, and their control grids are connected respectively to the corresponding conductors of the thousands set 114. The next ten tubes represent the hundreds digit values and are connected to the ten conductors of the hundreds set 115. The third set of forty tubes represents the tens digit values and is likewise connected to the respective conductors of the tens set 116. Finally, the last set of ten tubes, including the tube 121, represent the units digit values and are connected respectively to the corresponding conductors of the units set 117. The identifier 111 is also provided with a series of forty discharge tubes 122, 123, one for each of the tubes 120, 121, and also with forty associated register relays 124, 125. The register tubes 122, 123 are connected through individual transformers 126, 127 to the anodes 128, 129 of the tubes 120, 121. The suppressor grids 130, 131 of the forty tubes 120, 121 are connected in multiple over conductor 132 to the secondary winding of a common transformer 133. The screen grids 134, 135 are connected to the positive pole of the anode battery, and as above noted, the control grids 136, 137, are connected through condensers 138, 139 to the multiple conductors 113.

Each of the remaining identifiers in the office, such as the identifier 112 illustrated conventionally, is similarly equipped and connected in multiple to the common connecting medium 113.

The office is also provided with an impulse generator 140 which is energized by a source of alternating current 141 and which produces in its output leads impulses of different phases in each successive cycle of the source 141. The successive phases are assigned respectively to the different identifiers 111, 112, etc., so that impulses of a characteristic phase are supplied by the generator 140 to each identifier. For example, impulses of phase No. 0 are supplied over lead 142 to the identifier 111, impulses of phase No. 1

are supplied over lead 143 to identifier 112, and impulses of other phases are supplied to other identifiers not illustrated in the drawings. The impulse generator may be of any suitable type such as those disclosed in Holden Patents 2,324,394 of July 13, 1943, 2,252,766 of August 19, 1941, and 2,285,815 of June 9, 1942.

Thus all of the identifiers in the office are permanently connected over the common connecting medium 113 to the photoelectric cells associated with the signal lamp panel. The usual connecting switches which serve to connect one of a plurality of equivalent devices with a common mechanism to the exclusion of the others have been dispensed with by the use of this common connecting medium and a signaling method in which impulses of different phases are used. Accordingly, the identification of a plurality of different lines may take place concurrently, all of said lines making use of the same lamp panel, without any interference between them. Each connection that is established seizes one of the identifiers for association therewith, and all identifiers in concurrent use are capable of receiving signals from the lamp panel over the common medium 113 by means of the phase method without mutual interference.

A description will now be given of the operations involved in the process of identifying a subscriber's line. Assume for this purpose that the subscriber of line 100 wishes 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 selector switch S. The switch S and the switch S—1 respond successively to the subscriber's dial 150 to extend his line to an idle trunk 101 outgoing in the desired direction. At any suitable time after the extension of the connection of the subscriber's line to the trunk 101 an idle one of the identifying mechanisms, such as the mechanism 111, is associated with the connection through a connecting device 144. As the subscriber continues to dial the remaining digits of the wanted designation, these digits may be registered either in the mechanism 111 or in any other suitable registering mechanism where they are later used to control the operation of the switches in the offices beyond and also to furnish the necessary information for printing the designation of the called subscriber's line.

As soon as the identifying mechanism 111 is ready to receive the identification of the calling line 100, the number of which is assumed to be "9090," relay 145 is operated to close a circuit over the established connection for the transmission of impulses of the phase characterizing the identifier 111. The circuit for these impulses may be traced from the impulse lead 142 through the lamp 146, contacts of relay 145, connector 144 through the circuits 147 of trunk 101 thence over the sleeve conductor of the established connection through the switches S—1, S and F over the sleeve conductor 148 of the calling line through the electrodes of the signal lamp 102 to battery 149. The lamp 102, which is individual to the line 100 and which is located in the lamp panel to represent the four digital values of the line designation, illuminates in response to each impulse received and darkens during the intervals between the impulses. Each light impulse from the lamp 102 is conducted by the plate 212 to the exit point 215 from whence it shines upon the No. 9 photoelectric cell 119. The cell 119 becomes excited and causes the flow of current from the positive pole of battery 110, conductor 151 through the electrodes of the cell 119, resistor 152 to ground. Each impulse of current flowing through the resistor 152 produces a positive voltage impulse on the No. 0 thousands conductor 153, and this voltage impulse is applied through the condenser 138 to the control grid 136 of the corresponding tube 120 in the identifier 111 and similarly to the control grids of the corresponding tubes of all other identifiers 112, etc. Each impulse applied to the control grid 136 (and likewise to the control grids of the tubes in the other identifiers) overcomes the negative bias from the battery 154 and raises the positive potential of the control grid. Simultaneously and in the same phase, impulses from the impulse lead 142 are applied through the discharge tube 155 to the primary winding of the common transformer 133 in the identifier 111. These impulses are induced in the secondary winding of the transformer and apply a positive potential to the suppressor grids 130, 131 of all tubes in the identifier 111. Since the control and suppressor grids of the single tube 120 in the identifier are raised at the same instant to a positive potential, the tube becomes conductive to the exclusion of other tubes, and current flows from the positive pole of battery 156 through the primary winding of transformer 126, anode 128, cathode 157 to ground. Each impulse in the primary winding of transformer 126 is induced in the secondary winding and causes the ionization of the control gap of the associated discharge tube 122. Tube 122 transfers its ionization, and current flows in the main discharge gap from the positive pole of battery, contacts of relay 158, winding of register relay 124, anode and cathode of tube 122 to the negative pole of battery 159. As soon as the tube 122 is fully ionized, the relay 124 operates in the circuit traced and remains energized independently of the control gap of the tube. Thus the signal lamp 102 individual to the calling line 100 is flashed by impulses of the phase characterizing the identifier 111, which is associated with the calling line, and the flashing lamp produces impulses of like phase which are applied over the common medium 113 to the discharge tubes in the identifiers representing the thousands digit of the calling line. However, only the tube 120 in the identifier 111 becomes effective in response to these impulses for the reason that only this tube is receiving impulses of the same phase on its suppressor grid. The result is that the flashing lamp 102 causes the energization of the register relay 124 which represents the thousands digit value of the calling line in the identifier 111, and the corresponding register relay in each of the other identifiers remains inert.

In like manner the flashing lamp 102, through the medium of the hundreds light-conducting plate 225, excites the No. 0 hundreds cell 160, which in turn causes impulses of like phase to be transmitted over conductor 161 to the control grid of the corresponding hundreds tube in the identifier 111 and to the corresponding tubes in the other identifiers. Only the No. 0 hundreds tube in the identifier 111 is operated, and in response thereto the corresponding hundreds register relay is energized to register the No. 0 hundreds digit. Similarly, the flashing lamp 102, through the medium of the tens and units light-conducting plates 229 and 246, respectively, causes the excitation of the No. 9 tens cell 162 and the

No. 0 units cell 163. The tens cell transmits its impulses to the identifiers, and the corresponding tens tube and register relay in the identifier 111 are operated to the exclusion of the other identifiers. The impulses produced by the No. 0 units cell 163 are applied through the condenser 139 to the control grid 137 of the units tube 121 and similarly to the control grids of the corresponding tubes in the other identifiers. As explained, only the tube 121 of the identifier 111 responds since its suppressor grid 131 is supplied with the same phase as the control grid 137. Accordingly, current flows through the anode-cathode circuit of the tube 121, and the impulses induced in the secondary winding of the transformer 127 cause the ionization of the tube 123, resulting in the operation of the register relay 125 characterizing the units digit "0" of the called line designation.

The four operated register relays 124, 125, may serve in any well-known manner to cause the printing of a ticket to identify the number of the calling line. At any suitable time the relay 145 is released to open the impulse lead and to establish ground connection on the holding conductor extending to the trunk 101. Also at any suitable time the identifier 111 is fully disconnected from the trunk 101 by the release of the connecting device 144. The operated register relays 124, 125 and the associated tubes are restored by operating relay 158 to disconnect the supply battery therefrom.

If a plurality of subscribers' lines, such as the lines 100 and 164, are calling at the same time, it is possible for them all to make use of the common lamp field for obtaining their several identifications therefrom. Line 100, for example, may seize the idle identifier 111, and line 164 may seize the next idle identifier 112. Although both identifiers are engaged concurrently they operate on different phases, and the lamp 102 individual to line 100 and lamp 103 individual to line 164 flash successively in the appropriate phases to cause the operating impulses to be returned to the identifiers. Both sets of impulses are returned by the photoelectric cells over the common group of conductors 113 to the identifiers 111 and 112 but the phase relation between the impulses makes it possible for the identifiers to receive and register the appropriate designations without any mutual interference.

What is claimed is:

1. The combination in a signaling system including a group of telephone lines, said lines having designations including a plurality of digital characters which vary in value from line to line, of a plurality of signal lamps individual respectively to said lines and arrayed in a definite order with respect to the digital characters of said lines, a plurality of identifiers common to said lines, means for connecting calling lines to respective idle identifiers, means for generating impulses of a plurality of different phases, the impulses of the different phases serving individually the different identifiers, circuit means controlled by each identifier in use for causing the signal lamp of the associated line to light in phase with the impulses serving said identifier, photosensitive devices responsive to the lighting of any lamp in said array for producing impulses in phase with the lighting of the lamp and representing the designation of the corresponding line, means for delivering the impulses produced by said photosensitive devices to all of said identifiers, impulse-responsive means in each identifier operative when the impulses delivered thereto by said photosensitive devices are of the same phase as the impulses serving such identifier, and means controlled by said impulse-responsive means for identifying the line to which the identifier is connected.

2. The combination in a signaling system of a group of lines, said lines having designations including a plurality of digital characters, of a plurality of signal lamps individual respectively to said lines and arrayed in a definite order with respect to the digital characters of said lines, a plurality of identifiers common to said lines, means for connecting a plurality of desired lines individually to idle identifiers, the connections between said lines and the respective identifiers existing concurrently, means for generating signals of a plurality of different phases, said phases being respectively individual to and characteristic of said identifiers, circuit means controlled by each identifier in use for causing the signals of the corresponding phase to flash the signal lamp of the associated line, light-sensitive devices responsive to the flashing of any lamp in said array for producing signals in phase with the flashing of the lamp and representing the designation of the corresponding line, means for transmitting the signals produced by said light-sensitive devices to all of said identifiers, and signal-responsive means in each identifier selectively operated by the signals of the corresponding phase transmitted from said light-sensitive devices to establish the identity of the line to which such identifier is connected.

3. The combination in a signaling system of a group of lines having identifying designations comprising a plurality of digital characters, a plurality of signal lamps individual respectively to said lines and arranged in a definite order with respect to the digital characters of said lines, a plurality of identifying mechanisms common to said lines, means for establishing concurrent connections between desired lines and said identifying mechanisms, each line being connected to a different one of said mechanisms, means for producing signal impulses of a plurality of different phases, said phases characterizing respectively said identifying mechanisms, circuit means controlled by all identifying mechanisms in concurrent use for flashing the lamps of the associated lines in the different phases characteristic of the corresponding identifying mechanisms, and means in said identifying mechanisms selectively responsive to the flashing of said lamps for establishing in each mechanism the identity of the particular line to which said mechanism is connected.

4. The combination in a signaling system of a group of lines having identifying designations comprising a plurality of digital characters, a plurality of signal lamps individual respectively to said lines and arranged in a definite order with respect to the digital characters of said lines, a plurality of identifying mechanisms common to said lines, means for establishing concurrent connections between desired lines and said identifying mechanisms, each line being connected to a different one of said mechanisms, means for producing signal impulses of a plurality of different phases, said phases characterizing respectively said identifying mechanisms, circuit means controlled by all identifying mechanisms in concurrent use for flashing the lamps of the associated lines in the different phases characteristic of the corresponding identifying mechanisms, light-sensitive devices responsive to the

flashng of said lamps for producing impulses of the corresponding phases and characteristic of the designations of the corresponding lines, circuit means connecting said light-sensitive devices in permanent multiple relation with all of said identifying mechanisms, said circut means serving to deliver the impulses of any phase produced by said light-sensitive devices to all of said identifying mechanisms simultaneously, and means in each identifying mechanism selectively responsive to impulses of the phase characterizing said mechanism for establishing the identity of the line to which the mechanism is connected.

5. The combination in a signaling system of a group of lines having designations comprising a plurality of digital characters, a plurality of signal lamps individual respectively to said lines and arrayed in a definite order with respect to the digital characters of said lines, a plurality of light-sensitive devices representing the different values of the digital characters of said designations, light-conducting means associated with the lamps in said array and serving to conduct the light from any lamp therein to said light-sensitive devices in accordance with the digital values of the designation of the corresponding line, and means controlled by said light-sensitive devices for establishing the designation of the line corresponding to any lighted lamp in said array.

6. The combination in a signaling system of a group of lines having designations comprising a plurality of digital places, the characters in each place varying in value, a plurality of signal lamps individual respectively to said lines and arrayed in a definite order with respect to the designations of said lines, a plurality of light-sensitive devices representing the different values of the characters in each digital place of said designations, light-conducting elements, each element associated with the lamps of all lines having like character values in said digital places, said elements serving to conduct the light from any associated lamp to the corresponding light-sensitive device, and means controlled by said light-sensitive devices for establishing the identity of the line corresponding to any lighted lamp in said array.

7. The combination in a signaling system of a group of lines having designations comprising a plurality of digital places, the characters in each place varying in value, a plurality of signal lamps individual respectively to said lines and arrayed in a definite order with respect to the designations of said lines, a plurality of light-sensitive devices representing the different values of the characters in each digital place of said designations, a plurality of plates of light-conducting material, each plate being common to and disposed in light-conducting relation to the lamps of all lines having the same character value in a particular digital place, each plate also being disposed in light-conducting relation with the light-sensitive device which represents the same character value in the same digital place, said plates serving to conduct the light from any lighted lamp in said array to the light-sensitive devices which represent the designation of the associated line, and means controlled by said light-sensitive devices for establishing the identity of the line.

8. The combination in a signaling system in which the lines of a group have designations comprising a plurality of digital characters of a line identifying mechanism comprising a panel of light-conducting plates having an array of apertures therein, signal lamps disposed within said apertures, said lamps being individual respectively to the lines of said group and located in said array of apertures in a definite order with respect to the designations of said lines, each of said plates being common to and associated with the lamps of all lines having designation digits of like value, light-sensitive means representing the digital values of said designations, said plates serving to conduct the light from any lamp in said array to the light-sensitive devices representing the designation of the corresponding line, and registering means operated by said light-sensitive devices.

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