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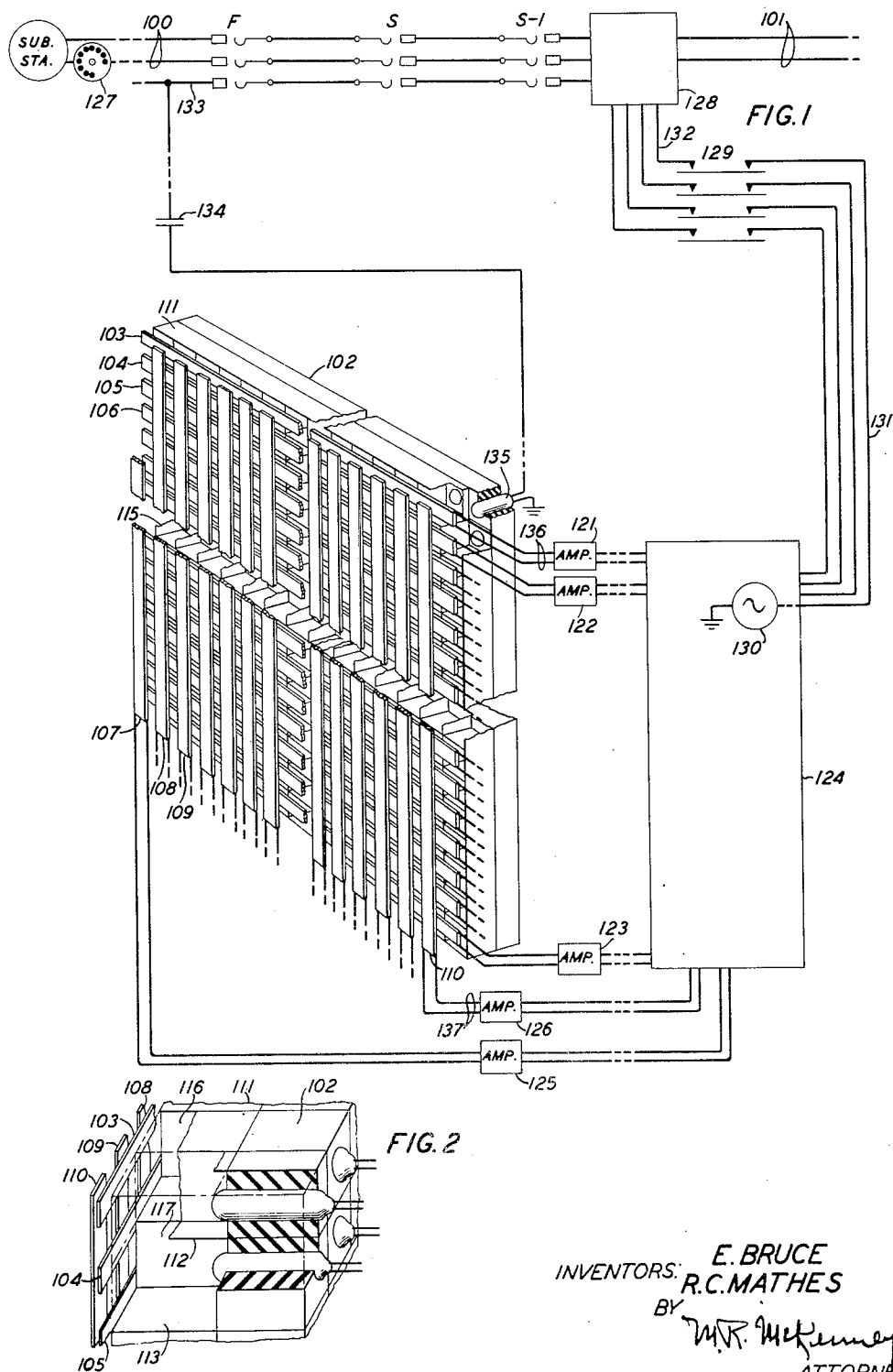
E. BRUCE ET AL

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ELECTRIC SIGNALING

Filed June 27, 1942

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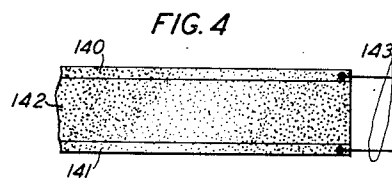
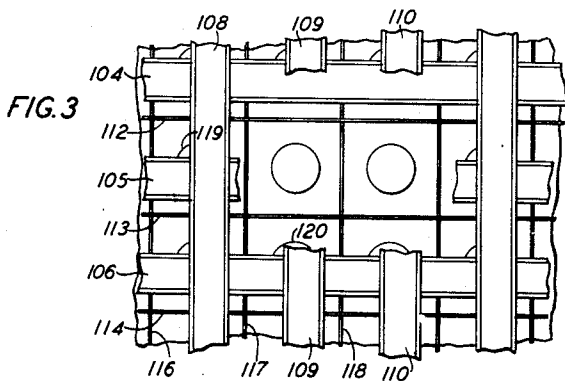
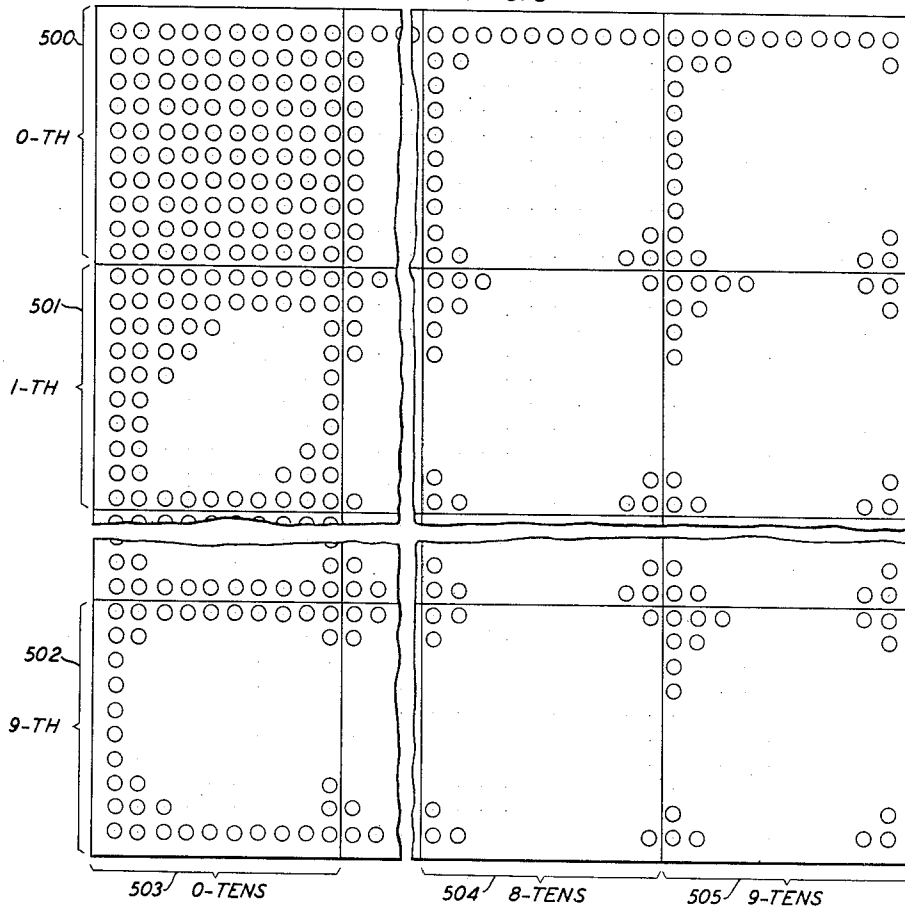
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FIG. 5



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ELECTRIC SIGNALING

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4 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 economical types of photoelectric devices for detecting the identity of the line; to obviate the necessity of optical systems for focussing the light; 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 of a coordinate field or array of signal lamps, representing individually the lines of the group, together with a coordinate arrangement of light-sensitive elements superimposed upon the lamp array for determining the location of any one of said lamps in the array in response to its illumination. 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 light-sensitive elements, preferably in the form of continuous strips, are arranged in a grid array which is superimposed upon the lamp field in such a way that the light from each lamp shines on the intersection of a light-sensitive strip in one coordinate direction and a light-sensitive strip in the other coordinate direction. If it is assumed, for example, that the lamp array contains one hundred horizontal rows and one hundred vertical rows of lamps, the light-sensitive grid structure likewise comprises one hundred horizontal light-sensitive strips and one hundred vertical strips. In order to avoid the necessity of providing light-focusing means, the individual lamps are enclosed in cells and the light-sensitive grid structure is secured to the face of the array so that the light from each lamp shines directly on the intersection of the two corresponding strips and does not shine on any other strip. The currents generated in the light-sensitive strips, of which there are one hundred in one coordinate direction and one hundred in the other coordinate direction, may be amplified by any suitable means and applied to any well-known form of translating mechanism for indicating or registering the decimal designations of the lines represented by the lamp array.

Other features of the invention will be described 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 is an enlarged perspective detail of the lamp field shown in Fig. 1;

Fig. 3 is an enlarged plan view of a portion of the lamp field;

Fig. 4 is an enlarged detail of one of the light-sensitive strips associated with the lamp field; and

Fig. 5 illustrates the field or panel of lamps representing the subscribers' lines in an office and serving to identify the lines by their numbers.

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 the drawings, the automatic telephone system illustrated in Fig. 1 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 illustrated in the drawings appears in the bank of line finder switch F which is associated with a first selector switch S. The selector switch S may have direct access to outgoing trunks, or, as shown, it may have access through a succeeding selector switch S-1 to trunks outgoing to distant offices such as the trunk 101.

The designation or identity of each line that establishes a toll call over one of the outgoing trunks 101 is obtained by a field of signal lamps mounted in a panel 102. This field of signal lamps 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. 5, 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 500 represents the No. 0 thousands group of lines, the horizontal group of lamps 501 represents the No. 1 thousands group of lines, the horizontal group 502 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 groups of all hundreds groups. For example, vertical groups 503, 504 and 505 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.

Returning to Fig. 1, the lamp panel 102, which may be of any suitable material, is provided with one hundred rows of holes or apertures, and the lamps are mounted in these holes in horizontal and vertical rows so as to emit their light from the front of the panel as seen in the figure. The light from these lamps is directed to shine selectively upon a network of photosensitive strips arranged immediately in front of the lamp panel. The photo-sensitive network consists of one hundred horizontal strips 103, 104, 105, 106, etc., which correspond to the thousands and hundreds digits, and one hundred vertical strips 107, 108, 109, 110, etc., which correspond to the tens and units digits of the lines represented by the lamps in the panel.

Each one of these photo-sensitive strips may comprise a backing of cloth or a plastic material such as glass or any other suitable material on the surface of which a coating of light-responsive substance is disposed. For example, these strips may be made, as seen in Fig. 4, by spraying bands 140, 141 of conductive material, such as silver, along the edges of a strip of insulating material 142 and then spraying the entire surface with some suitable photo-sensitive substance, such as selenium. According to the substance employed a change in resistance is effected by light shining on the strip, producing a corresponding change of current in the associated circuit 143, or a change of potential is produced between the conductive bands 140 and 141, resulting in a corresponding current flow in circuit 143.

The grid or network of photo-sensitive strips is arranged as seen in Figs. 1, 2 and 3 in front of the lamp panel so that the horizontal and vertical rows of intersections between the horizontal and vertical strips coincide with the corresponding lamps in the field. This grid of photo-sensitive strips may be formed as shown with all of the horizontal strips on one side and all of the vertical strips on the other side, or the strips may be woven in any desired manner. A woven structure would be particularly easy to obtain if the individual strips were made of a flexible material such as cloth or of some pliable substance.

The light from the lamps in the panel 102 is directed selectively to the associated cross-points

in the photo-sensitive grid by means of a light-shielding structure located between the lamp panel and the grid. This structure comprises a series of horizontal plates or shields 111, 112, 113, 114, separating the successive rows of horizontal lamps together with a series of vertical shields or plates 115, 116, 117, 118, etc., separating the successive rows of vertical lamps. These shields form cubical cells for the lamps in the panel, confining the light for the respective lamps and causing it to shine only on the horizontal and vertical light-sensitive strips which intersect at the point opposite the associated lamp. This construction is more clearly understood from the details of Figs. 2 and 3. In Fig. 3, for example, it will be seen that the light shining from the signal lamp 119 is confined to the cell formed by the shields 112, 113, 116 and 117 and is permitted to impinge only upon the photo-sensitive strips 105 and 108. Similarly the light shining from the lamp 120 is confined to the cell formed by shields 113, 114, 117 and 118 and is permitted to impinge only upon the photo-sensitive strips 106 and 109. Although the precise location of the horizontal and vertical strips of the grid structure with respect to the signal lamps may be adjusted as desired, the intersecting points of the strips are shown in Fig. 3 in a displaced position relative to the lamps. This will be seen by observing the location of the lamp 119 with respect to the area of intersection formed by the associated strips 105 and 108. By displacing the intersecting area of the strips with respect to the center of the lamp it is possible to obtain a better distribution of the light upon the intersecting strips.

The one hundred horizontal photo-sensitive strips are connected respectively to individual amplifiers 121, 122, 123, and thence through a connector, if desirable, to the registering and identifying mechanism 124. Similarly, the hundred vertical photo-sensitive strips 107, 108, 109, etc., are connected through individual amplifiers 125, 126, through a connector to said registering and identifying mechanism.

Each of the individual signal lamps in the panel 102 is connected to the sleeve or control conductor of the subscriber's line which it represents, and the current for lighting the lamp is transmitted over this control conductor as will be explained more fully hereinafter.

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 selector switch S. The switch S and the switch S-1 respond successively to the subscriber's dial 127 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 subscriber's line to the trunk 101, an idle registering and identifying mechanism 124 is associated with the connection. The connection of the mechanism 124 with the controlling circuits 128 of the trunk 101 is effected by a suitable connecting device 129. As the subscriber continues to dial the remaining digits of the wanted designation these digits may be registered in the mechanism 124 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 mechanism 124 is ready to receive the identification of the calling line 100, it establishes connection with the identifying lamp panel 102 through suitable connectors provided for that purpose. Also a circuit is closed from the source of energy 130 over conductor 131, connector 129, conductor 132, thence over the sleeve conductor through the switches S-1, S and F to the sleeve conductor 133 of the subscriber's line 100. The circuit is completed from conductor 133 through a condenser 134 to the lamp 135 which is individual to the line 100 and occupies the numerical position in the panel 102 corresponding to the number of the line. Light from the lamp 135 shines on the photoelectric strips 103 and 110 causing a change in the current flow in circuits 136 and 137. These currents are amplified by the amplifiers 121 and 126 and are then delivered to the registering and identifying mechanism 124. Any suitable means may be provided in the mechanism 124 to respond to these currents and to register the designation of the line 100. Thereafter the registered information may be transferred to the controlling circuits 128 where it serves to operate a ticket printer to print the number of the subscriber's line together with the other information about the call. After all the necessary operations have been performed, the identifying mechanism 124 is disconnected from the lamp panel 102 and from the controlling circuits 128.

The mechanism 124 corresponds in its purposes and operation and, if desirable, may also correspond in large measure with the structure of the register-sender and identifying mechanisms fully disclosed and described in Gooderham Patent 2,300,829 of November 3, 1942, and in the application of Gooderham, Serial No. 448,782 filed June 27, 1942. The registers on which the thousands, hundreds, tens and units digits of the calling line number are registered may be the well-known relay registers which are so universally used in register senders of the automatic telephone art. The amplified currents flowing over the thousands and hundreds leads from the photosensitive strips 103, 104, etc., operate the corresponding thousands and hundreds relay registers in the mechanism 124; and, similarly, the currents flowing over the tens and units leads from the photo-sensitive strips 107, 108, etc., operate the tens and units relay registers in said mechanism. Reference, therefore, is made to the patent and to the application above noted for a full understanding of the manner in which the mechanism 124 is seized in response to the dialing by the calling subscriber, and connected to the ticketing trunk 101 through the connector 129, of the manner in which the digits of the called line are registered in mechanism 124, of the manner in which the tone current is sent from source 130 over the sleeve of the connection to cause the identifying circuits to identify the particular line calling and to register the digits of the number of this line in the mechanism 124, 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.

What is claimed is:

1. In a telephone system, in which the lines of a group have designations, each of which comprises a plurality of characters, said characters varying in value from line to line, the combina-

tion of a plurality of signal lamps individual respectively to said lines, said lamps being arrayed in a field in coordinate 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 light-sensitive strips arranged in an intersecting array and disposed in coincident relation to said field of lamps, means for illuminating the particular one of said lamps corresponding to any desired line of said group, the light therefrom shining on and serving to energize the pair of light-sensitive strips having their intersection coincident to said illuminated lamp, and means responsive to the pair of energized strips for identifying 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, the order of the individual lamps in said rows bearing a definite relation to the values of the designation characters of said lines, a series of light-sensitive elements, one for each horizontal row of lamps, each of said elements arranged adjacent to the row of lamps it represents, a second series of light-sensitive elements representing respectively the vertical rows of lamps, each of the elements of said second series being arranged adjacent the lamps of the vertical row it represents, means for illuminating the particular one of said lamps corresponding to any desired line of said group, the light therefrom shining on and energizing the pair of light-sensitive elements which represent the intersecting horizontal and vertical rows containing the illuminated lamp, and means responsive to the energized light-sensitive elements for identifying 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 of coordinate horizontal and vertical 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 series of horizontally arranged light-sensitive strips, one for each of said horizontal rows of lamps, a second series of vertically arranged light-sensitive strips, one for each vertical row of lamps, said horizontal and vertical strips forming a grid structure disposed with the coordinate points of intersection coinciding with the signal lamps of said field, light shields interposed between the lamps of said field and said grid structure of light-sensitive strips for guiding the light from each lamp selectively to the corresponding pair of intersecting strips, means for lighting any lamp in said field to energize the associated pair of light-sensitive strips, and means controlled by the energized strips for identifying the designation of the corresponding line.

4. In a signaling system comprising a group of lines having individual designations, each of which comprises a plurality of digital characters, the combination of a plurality of signal lamps individual respectively to said lines, said lamps being arranged in a field in 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 light-sensitive elements, one for each of said rows of lamps, each light-sensitive element comprising a mounting strip, a pair of conductors affixed to said strip and a light-sensitive substance covering the surface of said strip and said conductors, a circuit for each of said light-sensitive elements connected to the conductors thereof, means for causing the light from the lamps in each of said rows to impinge upon the associated light-sensi-

5 tive element to produce a change of current flow in the associated circuit, means for illuminating the particular one of said lamps corresponding to any desired line in said group, and means responsive to the current flowing in the circuit connected to the corresponding light-sensitive element for identifying the designation of the desired line.

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