May 6, 1941. W. H. T. HOLDEN ET AL 2,241,031

TELEPHONE SYSTEM

Filed Jan. 23, 1940 4 Sheets-Sheet 1

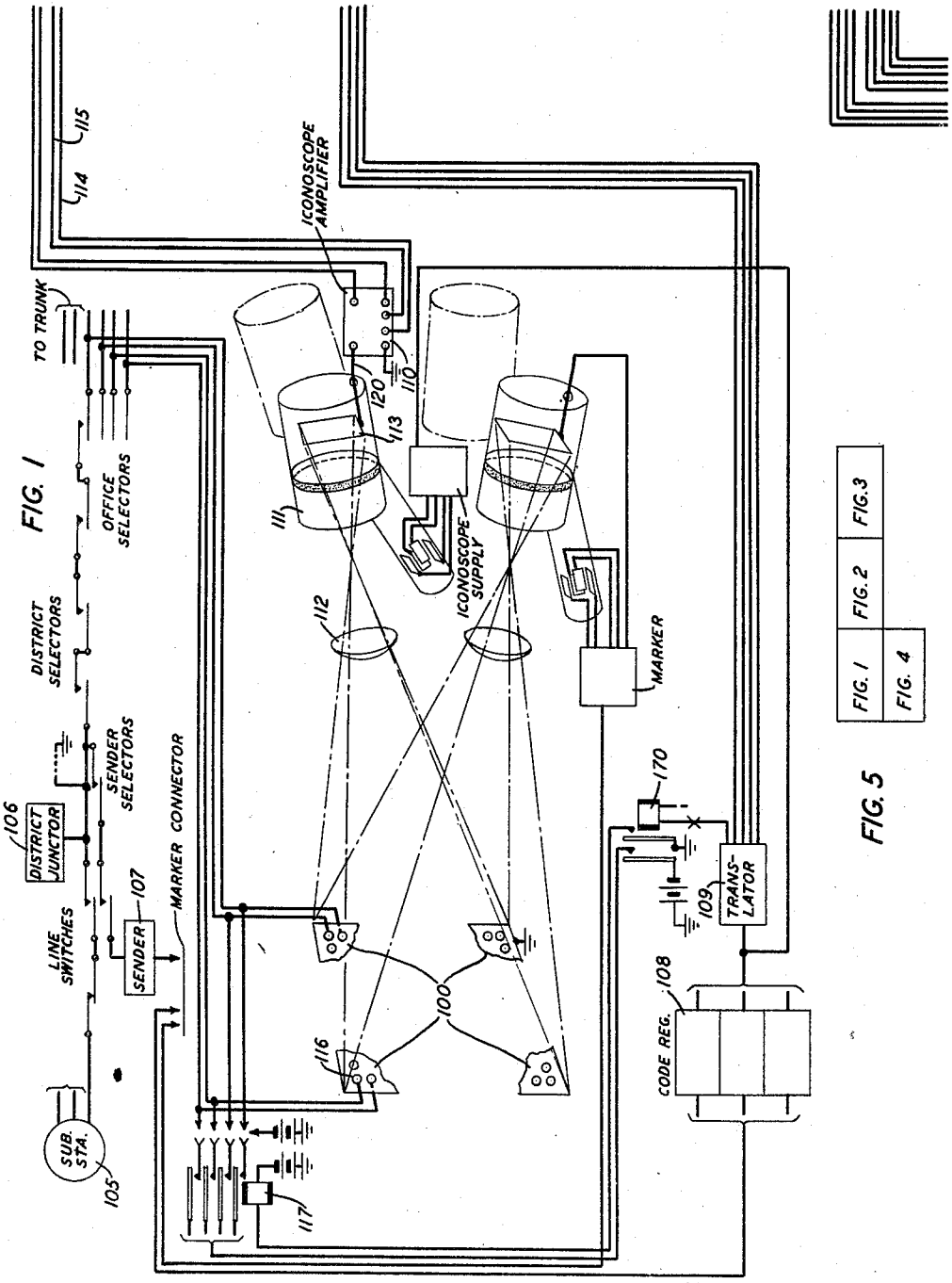

FIG. 1

FIG. 5

FIG. 1	FIG. 2	FIG. 3
	FIG. 4	

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TELEPHONE SYSTEM

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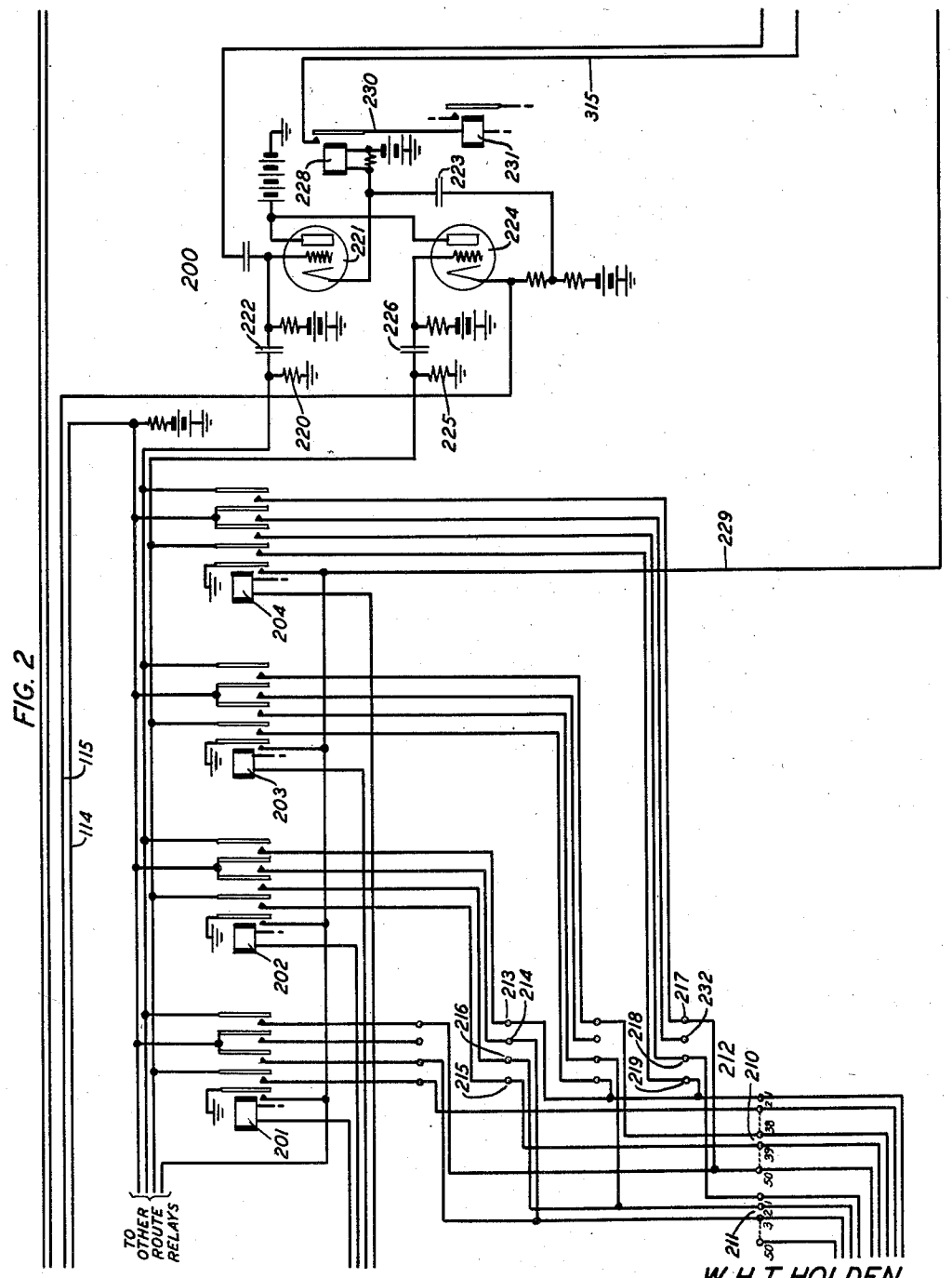

FIG. 2

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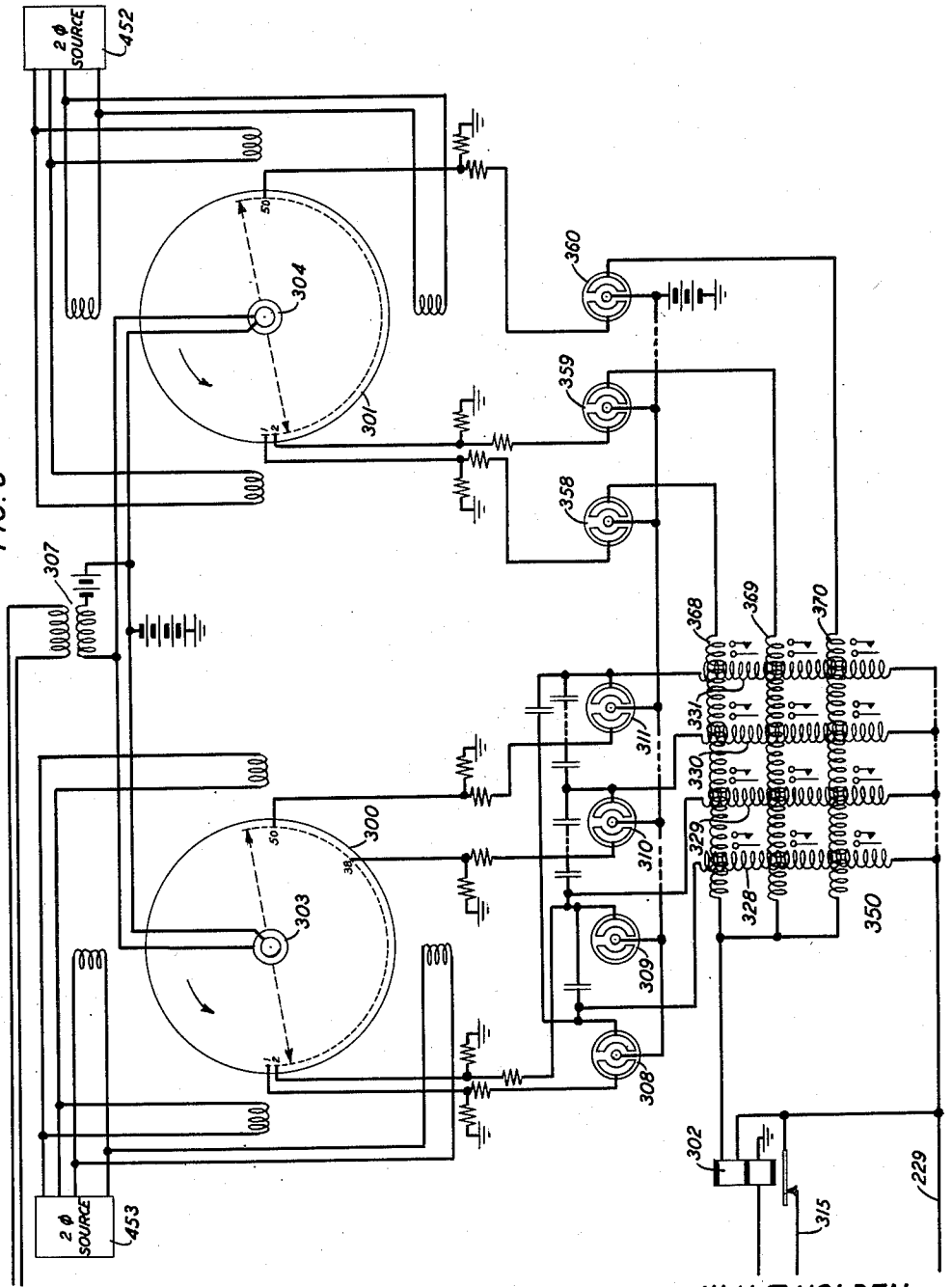

FIG. 3

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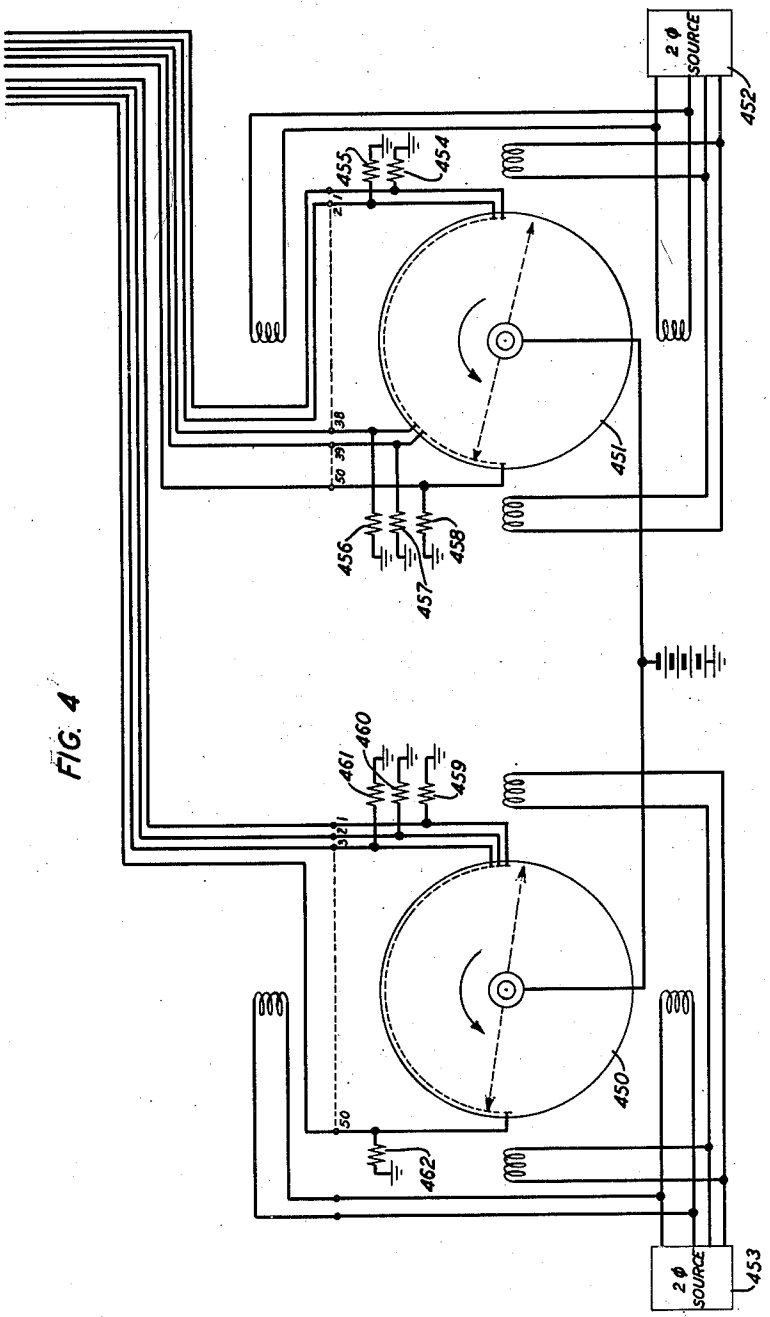

FIG. 4

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UNITED STATES PATENT OFFICE

2,241,031

TELEPHONE SYSTEM

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Application January 23, 1940, Serial No. 315,142

11 Claims. (Cl. 179—18)

This invention relates to telephone systems and has for its object to improve such systems by the use of novel equipment.

More specifically, the invention contemplates the identification of desired pieces of equipment by establishing a field of lights and scanning the field by means of an electric "eye."

The invention may be embodied, for example, in means for selecting an idle trunk by a marker in the cross-bar system. Lamps corresponding to all the trunks outgoing from an office are arranged in a bank, with means for lighting the lamps corresponding to idle trunks. An image of this bank is focussed on the screen of a cathode ray tube, known as an iconoscope, which scans the bank, and signals when an idle trunk is reached.

A further feature of the invention comprises the provision of means for rendering the scanning equipment effective only while scanning the desired group of trunks.

Another feature of the invention contemplates the control of the effectiveness of the scanning and the identification of the selected trunk by the use of two radial beam tubes in which the beams move in synchronism with the two scanning motions of the iconoscope.

As a modification, to reduce current consumption, the lamps may be lighted only when scanning is to take place, and only those lamps will be lighted which belong to the group of trunks leading to the wanted office.

These and other features of the invention will be more apparent from a consideration of the ensuing description in connection with the drawings, in which:

Fig. 1 shows, in diagrammatic form, a telephone connection between a calling line and an outgoing trunk, a sender and a marker, as well as the lamp panel common to the trunks, and the scanning tubes for a plurality of markers;

Fig. 2 shows the route relays and their cross-connections;

Fig. 3 shows the radial beam tubes which identify the trunk;

Fig. 4 shows the radial beam tubes which control the iconoscope amplifier; and

Fig. 5 shows the manner in which Figs. 1 to 4 are to be arranged.

Certain aspects of this disclosure form the basis for the copending application of O. B. Blackwell, Serial No. 315,149, filed January 23, 1940.

Reference is here made to Patent No. 2,235,803, granted March 18, 1941, to W. W. Carpenter, for a detailed description of a telephone system of the type in which the present invention may be employed.

In such a system a calling subscriber, on initiating a call, is connected over primary and secondary line switches to a district junctor circuit and through primary and secondary sender selectors to a sender. The subscriber then dials the wanted number which is recorded in the sender. When the sender has received the digits identifying the office in which the wanted line is located, the sender associates itself with an idle marker through a marker connector and transmits these digits to the marker. The marker translates these digits and operates a route relay which identifies the trunks leading to the wanted office.

In the Carpenter patent, the route relay causes the association of the identified trunks in groups with a set of test relays, in order to find an idle one, after which the channels connecting the district junctor with the selected trunk are tested and an idle set of district and office selectors are operated. When this connection is established, the outgoing trunk is marked with ground by the district junctor.

According to the present arrangement, a lamp is provided for each outgoing trunk in the lamp bank 100. The trunks outgoing to a particular office are arranged in a single group in the bank, irrespective of the positions of the trunks on the trunk frame. The lamps are all connected to ground at one side and to battery on the other and therefore are normally lighted. When a trunk becomes busy, the busy ground shunts the lamp and extinguishes it.

When the subscriber at substation 105 is connected to district junctor 106 and sender 107, he dials the wanted designation. The sender 107 calls in a marker and transfers the code digits to the marker registers 108. These digits are translated by means indicated as translator 109 and cause the operation of one of the route relays 201 to 204, for example relay 204. This relay identifies the office in which the wanted line is located and thereby the group of trunks to be used.

Each marker has an iconoscope such as iconoscope 111, provided with a screen 113 made up of photoelectric elements corresponding in number to the number of lamps, and these iconoscopes are arranged before the lamp bank so that the image of the lamp bank may be focussed by suitable means, indicated by lens 112, on the screen 113. In this way, one lamp bank serves all of the markers of the office. The iconoscopes of four markers are indicated in Fig. 1.

The image of the lamp bank is swept in the usual manner by a scanning beam of electrons controlled by a sweep circuit providing both a horizontal and a vertical sweep, as shown in U. S. Patent 2,178,464 to M. W. Baldwin, October 31, 1939.

Whenever the beam of electrons in the iconoscope traverses an illuminated spot on the screen there will be an impulse of voltage on the iconoscope output lead 120.

Assuming that there are twenty-five hundred lamps and twenty-five hundred elements, the frequency of one sweep will be one-fiftieth of the other. Two interlocked oscillators (not shown) may be used to supply the sweep frequencies. The output of the iconoscope is fed to amplifier 110.

In order to limit the iconoscope amplifier to indications on only a particular trunk group, the output therefrom is blocked except when the beam is sweeping over those spots in the screen receiving light from lamps of a particular trunk group. To this end conductors 114 and 115 are connected to the control circuit 200 which applies either positive or negative potential to them, under the control of the route relays 201, etc., and the timing circuit of Fig. 4. When either conductor 114 or conductor 115 is negative, the output of the amplifier is blocked, while when both conductors are positive, output from the amplifier will be possible.

The blocking of the output of the amplifier 110 is controlled by two radial beam tubes 450 and 451, which provide a low voltage, high current beam. Tubes of this type are disclosed in Patent No. 2,217,774, granted Oct. 15, 1940, to A. M. Skellett. The beams of the tubes 450 and 451 are rotated by a revolving magnetic field, as described in the Skellett patent, produced from a two-phase alternating current supply. Tube 451 operates at high speed and its field supply, indicated at 452 but not shown in detail, is arranged so that one of its phases is in synchronism, with the horizontal sweep supply of the iconoscope 111. Tube 450 operates from a source 453 similar to source 452 but having one of its phases in synchronism with the vertical sweep supply of the iconoscope 111. Each tube has fifty anodes arranged to receive the beam, the beam in tube 451 traversing the entire fifty anodes while that in tube 450 traverses a single anode. A resistance 454, 455, etc., and 459, 460, etc., is connected between each of the anodes of tubes 450 and 451 and ground, and in parallel therewith a conductor leads from each anode to the fifty terminals on each of the blocks 210 and 211. These two terminal blocks are cross-connected to a plurality of groups of four terminals each on a block 212. Only four groups of terminals of four each, corresponding to the four route relays 201 to 204 are shown, but it is to be understood that there will be as many four-terminal groups and route relays as there are separate trunk group destinations to be reached by the decoder-marker.

It is evident that with twenty-five hundred trunks, represented by twenty-five hundred lamps in a bank fifty lamps wide and fifty lamps high, any trunk may be identified by two numbers, each of which may have any value from one to fifty and the two groups of fifty terminals of blocks 210 and 211, corresponding as they do to the positions of the beams in the tubes 450 and 451 and therefore to the position of the scanning beam in the iconoscope, also correspond to the coordinate numbers of the trunks.

Specifically, terminal 219 on the block 212, which may be called the group start terminal, is cross-connected to terminal No. 1 on block 210, while terminal 218, which may be identified as the trunk group terminal, is cross-connected to terminal No. 1 of block 211. If we assume that this group consists of fifty trunks, the group end terminal 217 will be connected to terminal No. 50 of block 210. If now, route relay 204 is operated, conductor 114 is connected to terminal 218 and receives a positive potential from the anode circuit of tube 450 so long as the electron beam in the tube rests on anode No. 1.

Terminal 219 is connected by relay 204 to resistance 225 in the input circuit of the thyratron 224. Therefore, as soon as the beam in tube 451 strikes the No. 1 anode, a positive pulse will be sent through resistance 225, operating thyratron 224 through condenser 226, extinguishing any arc which may exist in tube 221 by means of the commutating condenser 223 and applying positive bias to conductor 115. There is now positive bias on both conductors 114 and 115, unblocking the iconoscope amplifier. But tube 224 was operated by the arrival of the beam in tube 451 on anode No. 1 and conductor 114 was made positive by the beam of tube 450 resting on No. 1 anode in that tube. Owing to the synchronism between supplies 452 and 453 and the iconoscope sweep sources, however, this occurs when the iconoscope spot just arrives at the first element in the first row on which the image of lamp 116 which is the first lamp in the first horizontal row of lamp panel 100 is focussed. There will thus be output from the iconoscope amplifier for every lamp lighted in this row, beginning with the first.

Supposing first that no lamps are found lighted, corresponding to an all-trunks-busy condition, nothing will happen until the beam in tube 451 reaches anode No. 50, which was connected over terminal 217 and the outer right contact of route relay 204 to ground through resistance 220. When the beam in tube 451 reaches anode No. 50, a positive impulse will then pass over terminal 217 through condenser 222 to the grid of thyratron 221, causing an arc to strike therein, and extinguishing the arc previously struck in tube 224 by means of condenser 223. This removes positive bias from conductor 115 and again blocks the output of the iconoscope amplifier. As no trunk was found, route relay 204 remains operated, relay 228 operates in the output of tube 221 and closes a circuit from ground at the inner right contact of relay 204, conductor 229, back contact of relay 302, conductor 315, front contact of relay 228, conductor 230 and thence to the "trunks-busy" relay 231 which brings about the transmission of an overflow signal to the calling subscriber. Relay 231 would be timed in operating to prevent its premature operation.

For route relay 204, terminal 232 has no function. To understand the purpose of this terminal, suppose that the second trunk group, to which route relay 203 appertains, begins with the first trunk of the second row and ends with the thirty-eighth trunk of that row and that the third trunk group, to which route relay 202 appertains, begins with the thirty-ninth trunk of the second row and ends with the first trunk of the third row. In the case of this third group, group start terminal 215 is connected to terminal 39 of block 210, trunk group terminal 216

is connected to terminal No. 2 of block 211 and group end terminal 213 is connected to terminal No. 1 of block 210. Terminal 214, which is multipled to terminal 216 over the contacts of relay 202, is connected to terminal No. 3 of block 211. Therefore conductor 114 receives positive potential when the beam of tube 450 is on both the second and third anodes. A single terminal 214 permits trunk groups up to one hundred to be used. If more of such multiple contacts are provided, larger trunk groups may be used.

Referring now to Fig. 3, tubes 300 and 301 are radial beam tubes like tubes 450 and 451, but have modulating or control grids 303 and 304 which are normally so biased as to suppress the beam. The field coils of tubes 300 and 301 are excited from the same sources 453 and 452 as are the tubes 450 and 451, respectively. Therefore, the beams in tubes 300 and 301, when they exist, agree exactly in position with those in tubes 450 and 451, respectively. The output of the iconoscope amplifier 110 is fed to the control grids of tubes 300 and 301 by means of transformer 307, so that when the iconoscope beam strikes an illuminated screen element, and the amplifier is unblocked, the impulse to the grids 303 and 304 causes the beams of the tubes 300 and 301 to flash to the anodes of these tubes and they will encounter the anodes having the same positions in tubes 300 and 301 as those in tubes 450 and 451 on which the beams of the latter tubes are resting. This flash of the beams will cause one of the fifty cold cathode tubes 308, etc., associated with tube 300 to break down and also one of the fifty tubes 358, etc., associated with tube 301 to break down. Since the upper winding of relay 302 is included in the output of the cold cathode tubes, it will operate and open the circuit of trunks-busy relay 231. At the same time, the impulse generated in the lower winding of relay 302 will cause tube 221 to operate, extinguishing the arc in tube 224 and again disabling the iconoscope amplifier so that only one cold cathode tube operates in each of the groups associated with tubes 300 and 301.

The cathode circuits of tubes 308, 309, 358, 359, etc. pass through the windings of a cross coil switch 350 of the type described and claimed in Patent No. 2,187,115 to W. B. Ellwood and W. H. T. Holden, granted January 16, 1940. This switch has fifty vertical coils 328, 329, etc., and fifty horizontal coils 368, 369, etc., with a single pair of contact springs at each cross-point, whereby it includes twenty-five hundred contacts. One spring of all of these pairs is grounded, so that the operation of the switch connects ground to the particular conductor corresponding to the desired trunk. This can be utilized to connect the trunk to the district junctor. Such an arrangement suitably modified could be used in any type of switching system.

As an alternative to the blocking of the iconoscope amplifier, to limit the scanning to the group of trunks desired, a route relay like relay 170 might, as indicated, close circuits for only those lamps included in the group, thereby eliminating tubes 450 and 451 and the cross-connection blocks and tubes of Fig. 2. However, the time for holding the marker is so short that probably this would be satisfactory only if non-filamentary lamps were used.

The advantages of this arrangement lie both in the saving of equipment and in the saving of time, particularly where large trunk groups are involved.

What is claimed is:

1. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuits, a cathode ray tube, means to focus an image of said bank of lamps on the screen of said tube, means to scan said screen, means responsive to the cathode ray beam striking an illuminated point on the screen to stop the scanning operation and to identify the corresponding circuit, and means to render said last-mentioned means responsive during a predetermined limited portion of said scanning operation.

2. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuits, a cathode ray tube, means to focus an image of said bank of lamps on the screen of said tube, means to scan said screen, an amplifier in the output of said tube, means in the output of said amplifier responsive to the cathode ray beam striking an illuminated point on the screen to stop the scanning operation and to identify the corresponding circuit, and means to block said amplifier while scanning undesired portions of said screen.

3. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuit, a cathode ray tube, means to focus an image of said bank of lamps on the screen of said tube, means to scan said screen, means responsive to the cathode ray beam striking an illuminated point on the screen to stop the scanning operation and to identify the corresponding circuit, an amplifier between said tube and said responsive means, means driven in synchronism with the scanning beam of said tube, and means controlled by said last-mentioned means to block said amplifier while scanning undesired portions of said screen.

4. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuits, a cathode ray tube, means to focus an image of said bank of lamps on the screen of said tube, means to scan said screen, means responsive to the cathode ray beam striking an illuminated point on the screen to stop the scanning operation and to identify the corresponding circuit, an amplifier between said tube and said responsive means, cathode ray means driven in synchronism with the scanning beam of said tube, and means controlled by said last-mentioned means to block said amplifier while scanning undesired portions of said screen.

5. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuits, a selection control device comprising a cathode ray tube, means to focus an image of said bank of lamps on the screen of said tube, means to scan said screen, means in said selection control device to identify a wanted group of circuits, an amplifier, means controlled by said amplifier responsive to the cathode ray beam striking an illuminated

point on the screen to stop the scanning operation and to mark the corresponding circuit, and means under the control of said identifying means to render said amplifier effective only while said tube scans the corresponding portion of said image.

6. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuits, a cathode ray tube, means to focus an image of said bank of lamps on the screen of said tube, means to scan said screen, means responsive to the cathode ray beam striking an illuminated point on the screen to stop the scanning operation and to identify the corresponding circuit, an amplifier between said tube and said responsive means, a pair of radial beam cathode ray tubes driven in synchronism with the vertical and horizontal sweeps of said first cathode ray tube, and means under the joint control of said radial beam cathode ray tubes for blocking said amplifier while scanning undesired portions of said screen.

7. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuits, a cathode ray tube, means to focus an image in said bank of lamps on the screen of said tube, means to scan said screen, means responsive to the cathode ray beam striking an illuminated point on the screen to stop the scanning operation and to identify the corresponding circuit, an amplifier between said tube and said responsive means, a pair of radial beam cathode ray tubes driven in synchronism with the vertical and horizontal sweeps of said first cathode ray tube, means for normally blocking said amplifier and means under the joint control of said radial beam cathode ray tubes for rendering said blocking means ineffective while the desired part of said screen is being scanned.

8. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuits, a selection control device comprising a cathode ray tube, means to focus an image of said bank of lamps on the screen of said tube, means to scan said screen, means in said selection control device to identify, a wanted group of circuits, an amplifier, means controlled by said amplifier responsive to the cathode ray beam striking an illuminated point on the screen to stop the scanning operation and to mark the corresponding circuit, cathode ray means driven in synchronism with the scanning beam of said tube, and means under the joint control of said cathode ray means and said identifying means to render said amplifier effective only while said tube scans the corresponding portion of said image.

9. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuits, a selection control device comprising a cathode ray tube, means to focus an image of said bank of lamps on the screen of said tube, means to scan said screen, means in said selection control device to identify a wanted group of circuits, an amplifier, means controlled by said amplifier responsive to the cathode ray beam striking an illuminated point on the screen to stop the scanning operation and to mark the corresponding circuit, a pair of radial beam cathode ray tubes driven in synchronism with the vertical and horizontal sweeps of said first cathode ray tube, and means under the joint control of said radial beam cathode ray tubes and said identifying means to render said amplifier effective only while said first tube scans the corresponding portion of said image.

10. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuits, a selection control device comprising a cathode ray tube, means to focus an image of said bank of lamps on the screen of said tube, means to scan said screen, means in said selection control device to identify a wanted group of circuits, an amplifier, means controlled by said amplifier responsive to the cathode ray beam striking an illuminated point on the screen to stop the scanning operation and to mark the corresponding circuit, means for normally blocking said amplifier, means under the joint control of said radial beam cathode ray tubes for rendering said blocking means ineffective while the desired part of the screen is being scanned and means under the control of said identifying means for associating said radial beam cathode ray tubes with said amplifier.

11. In a telephone system, a plurality of circuits, a bank of lamps containing one lamp for each circuit, means to control the lighting of said lamps in accordance with the busy or idle condition of said circuits, a selection control device comprising a cathode ray tube, means to focus an image of said bank of lamps on the screen of said tube, means to scan said screen, a plurality of route relays, means in said selection control device to operate one of said relays individual to a wanted group of circuits, an amplifier, means controlled by said amplifier, responsive to the cathode ray beam striking an illuminated point on the screen to stop the scanning operation and to mark the corresponding circuit, means for normally blocking said amplifier, means under the joint control of said radial beam cathode ray tubes for rendering said blocking means ineffective while the desired part of the screen is being scanned, and means under the control of said relay for associating said radial beam cathode ray tube with said amplifier.

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