

Dec. 13, 1938.

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2,139,799

TELEGRAPH SWITCHBOARD SWITCHING SYSTEM

Filed Aug. 26, 1936

9 Sheets-Sheet 1

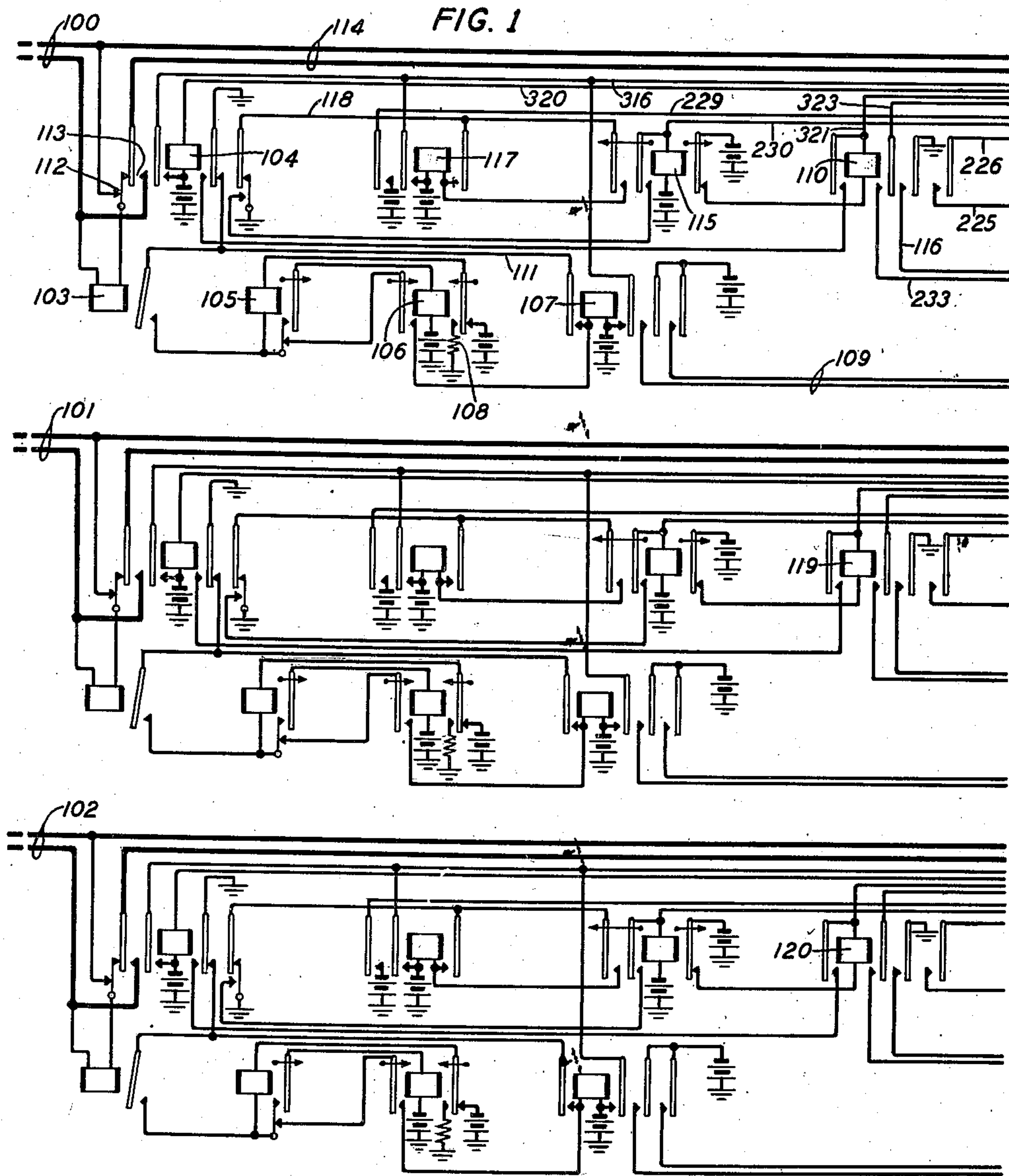


FIG. 1-A

FIG. 1	FIG. 2	FIG. 3
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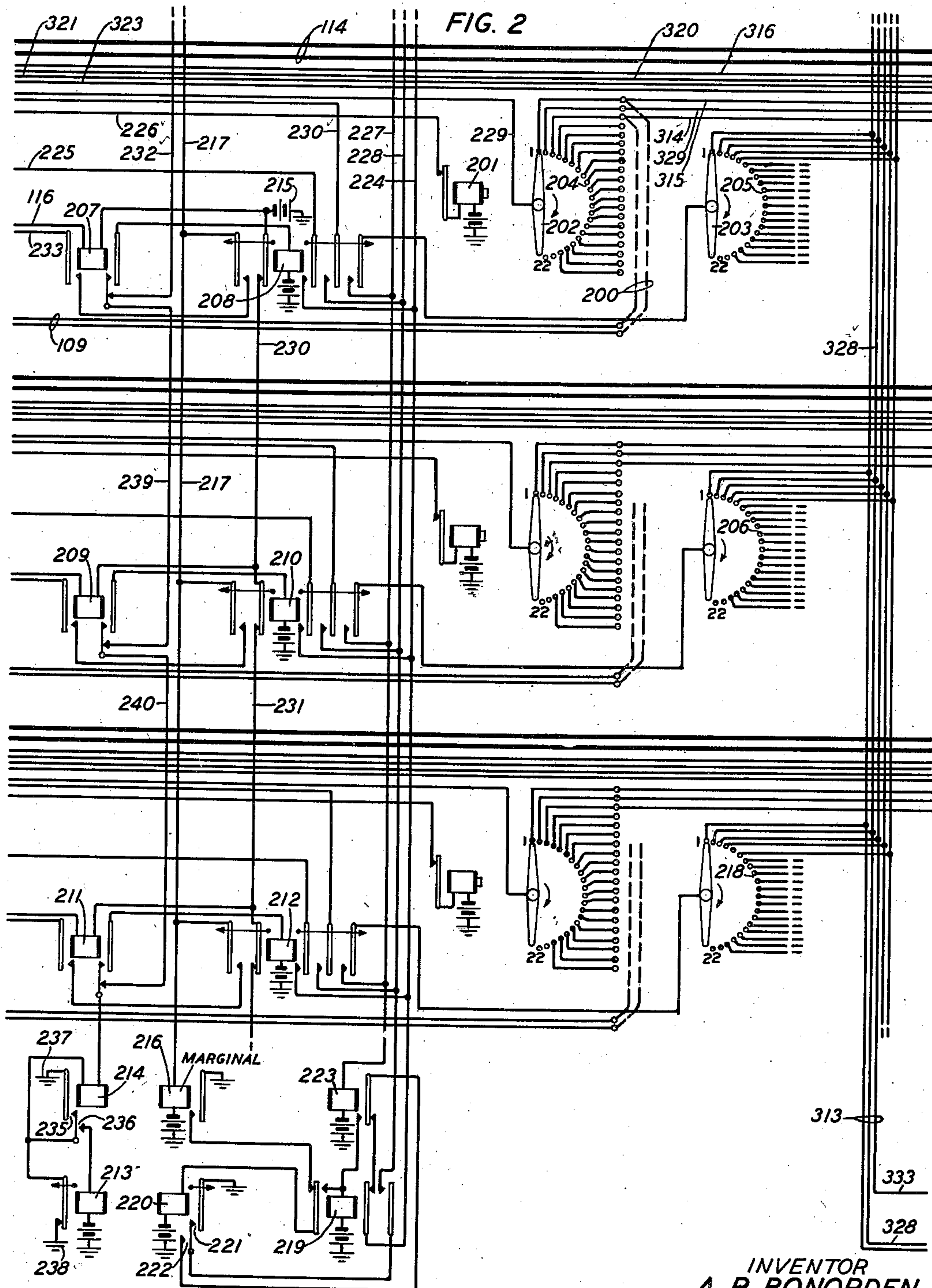
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TELEGRAPH SWITCHBOARD SWITCHING SYSTEM

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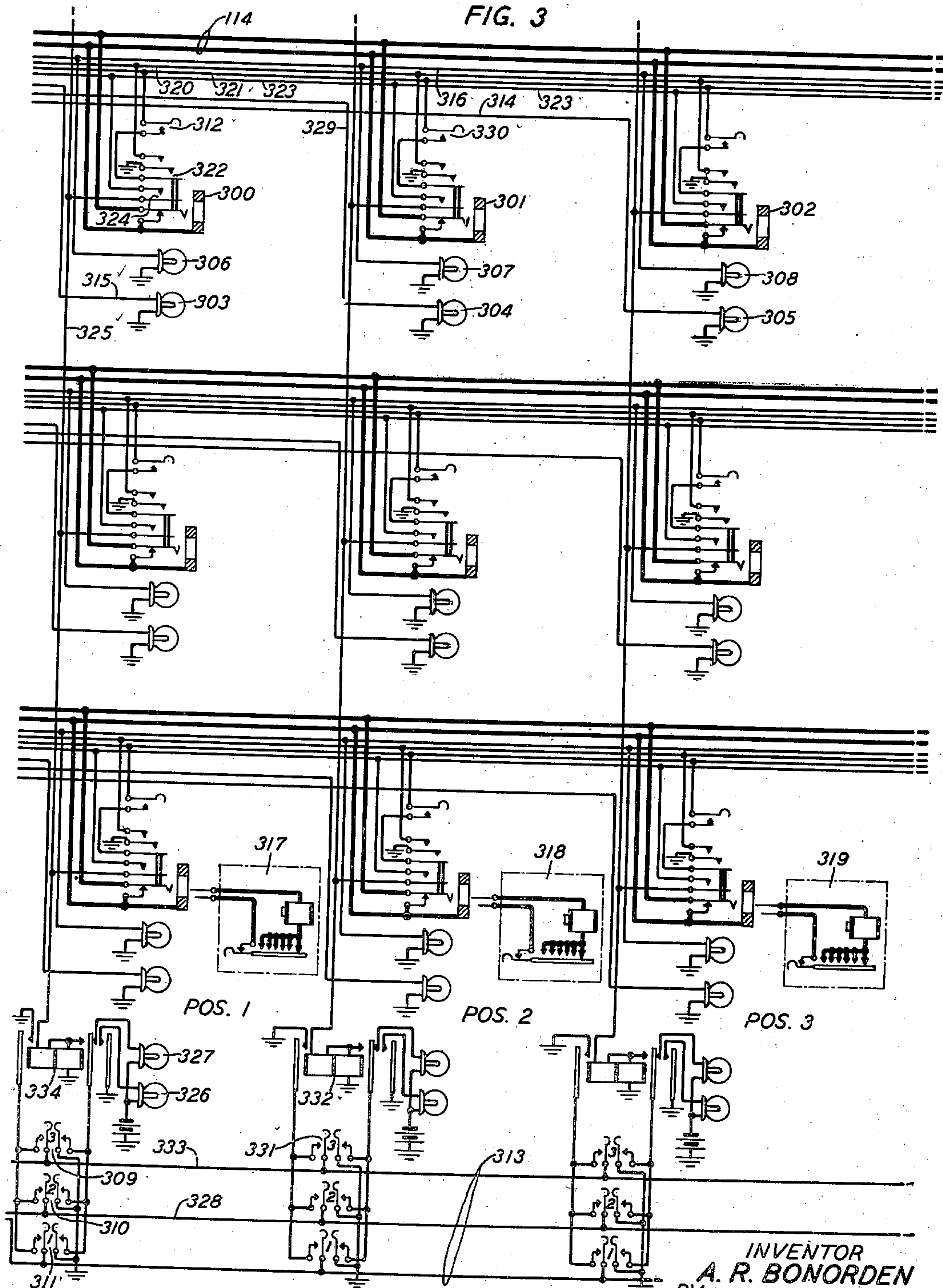
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TELEGRAPH SWITCHBOARD SWITCHING SYSTEM

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FIG. 3



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TELEGRAPH SWITCHBOARD SWITCHING SYSTEM

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FIG. 4

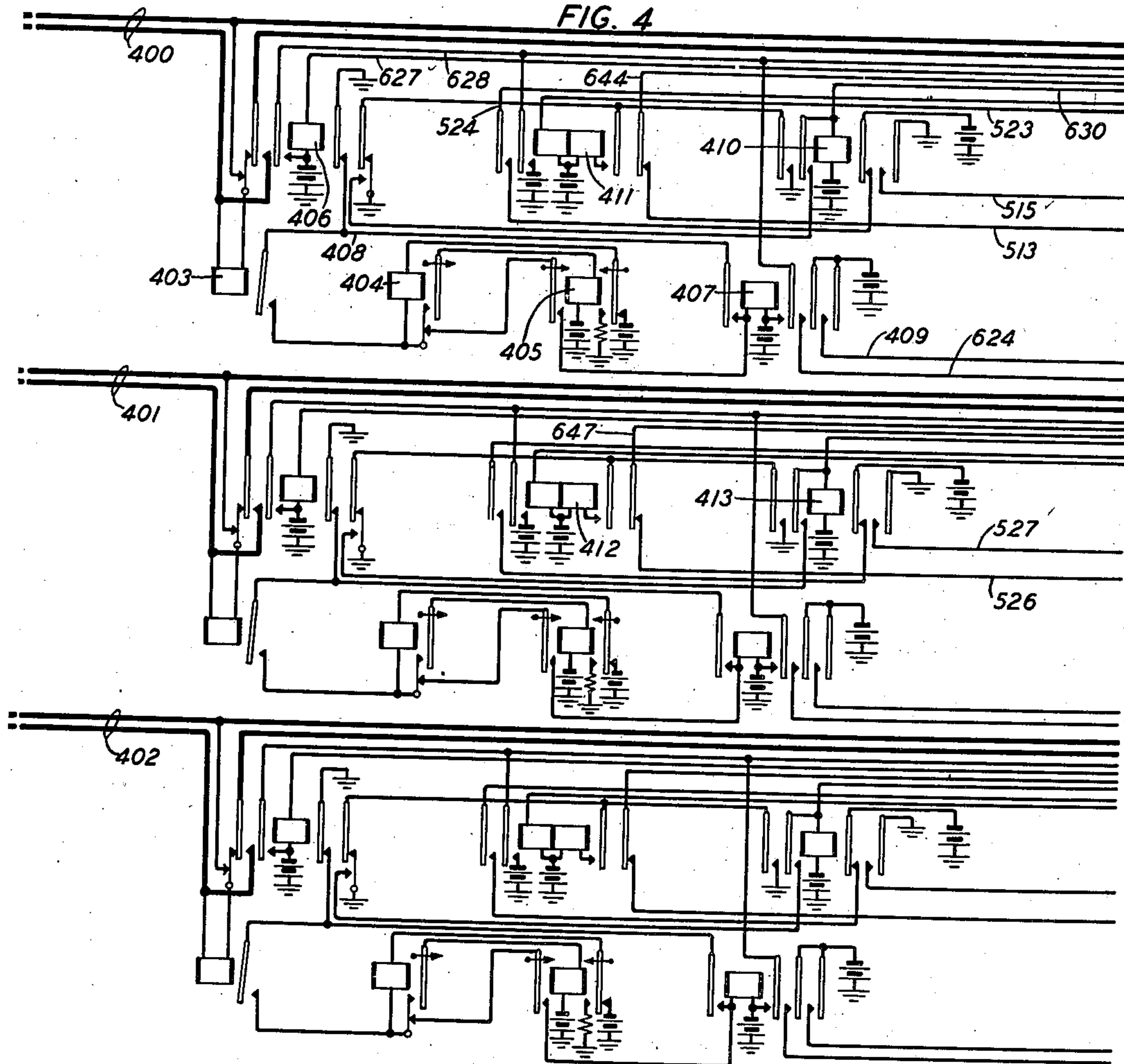


FIG. 4-A

FIG. 4	FIG. 5	FIG. 6
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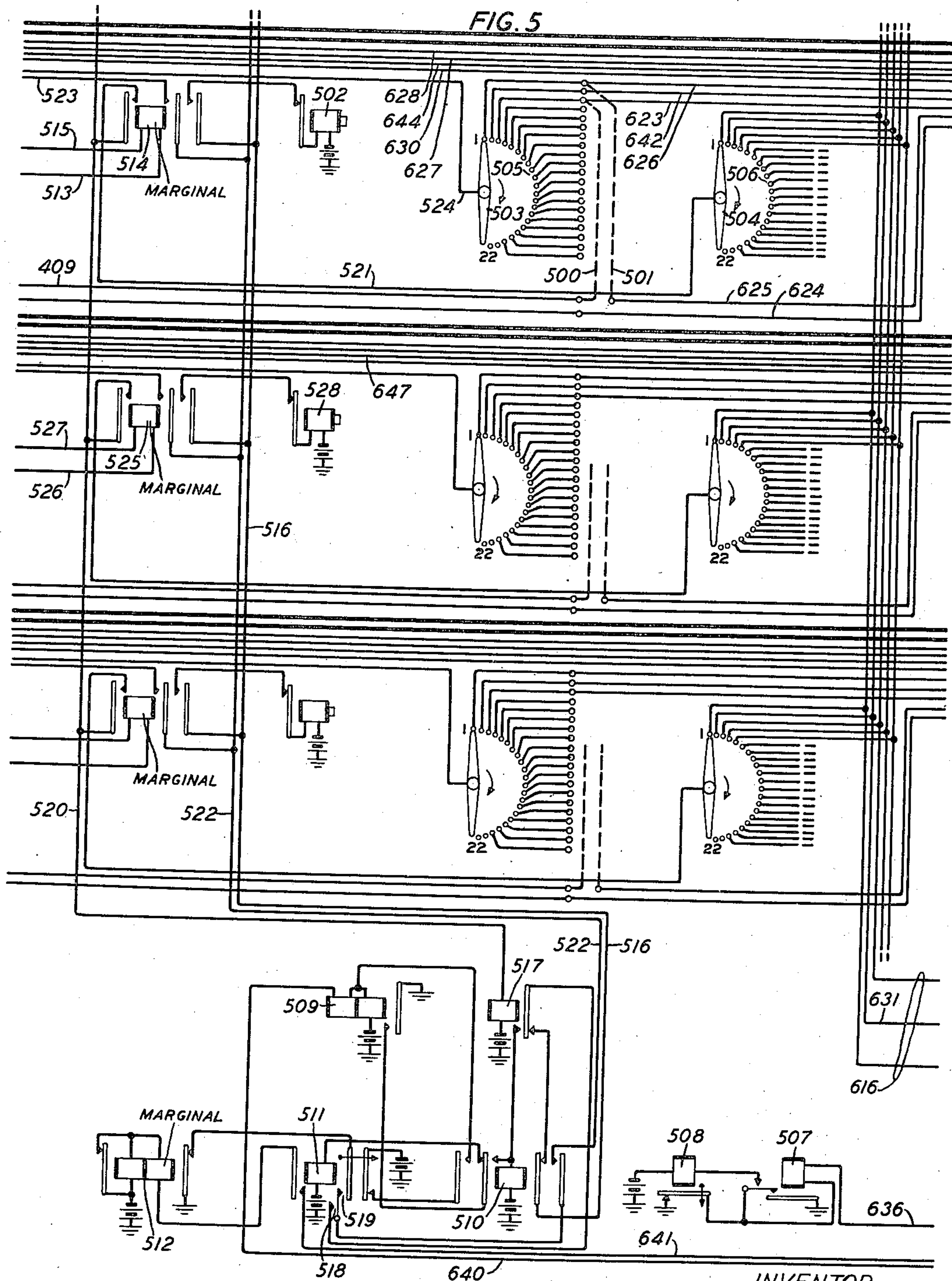
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TELEGRAPH SWITCHBOARD SWITCHING SYSTEM

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FIG. 5



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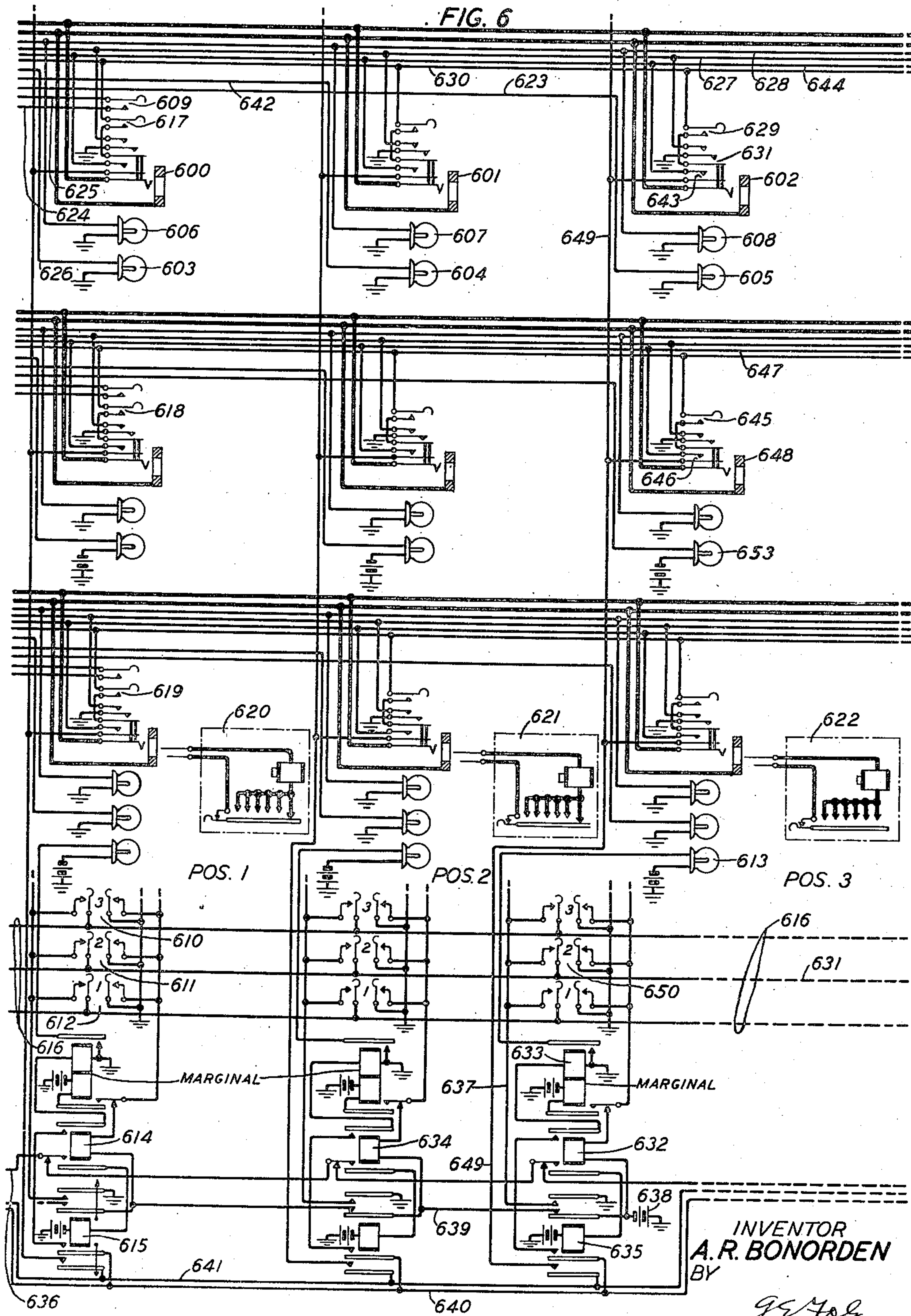
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TELEGRAPH SWITCHBOARD SWITCHING SYSTEM

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FIG. 6



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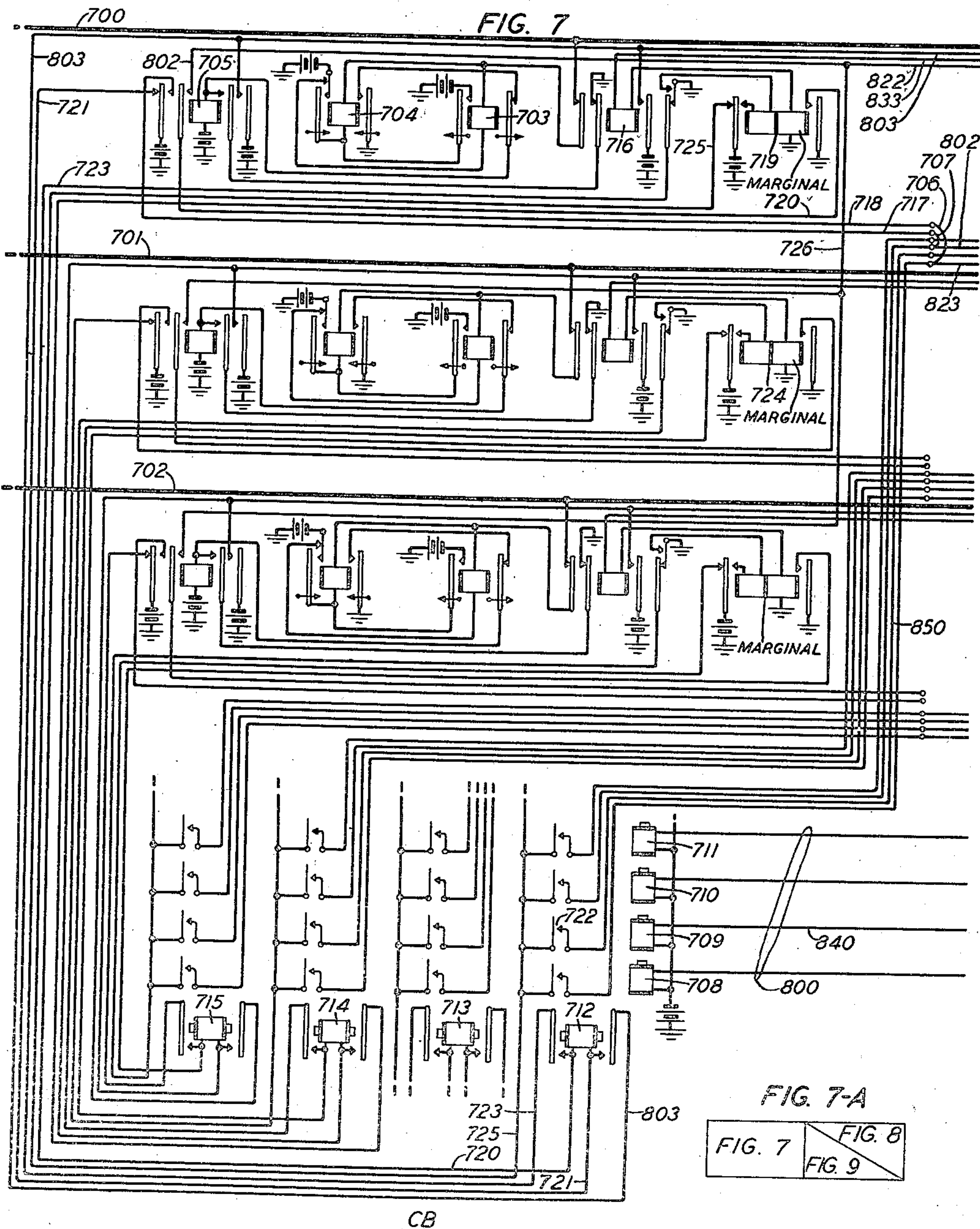
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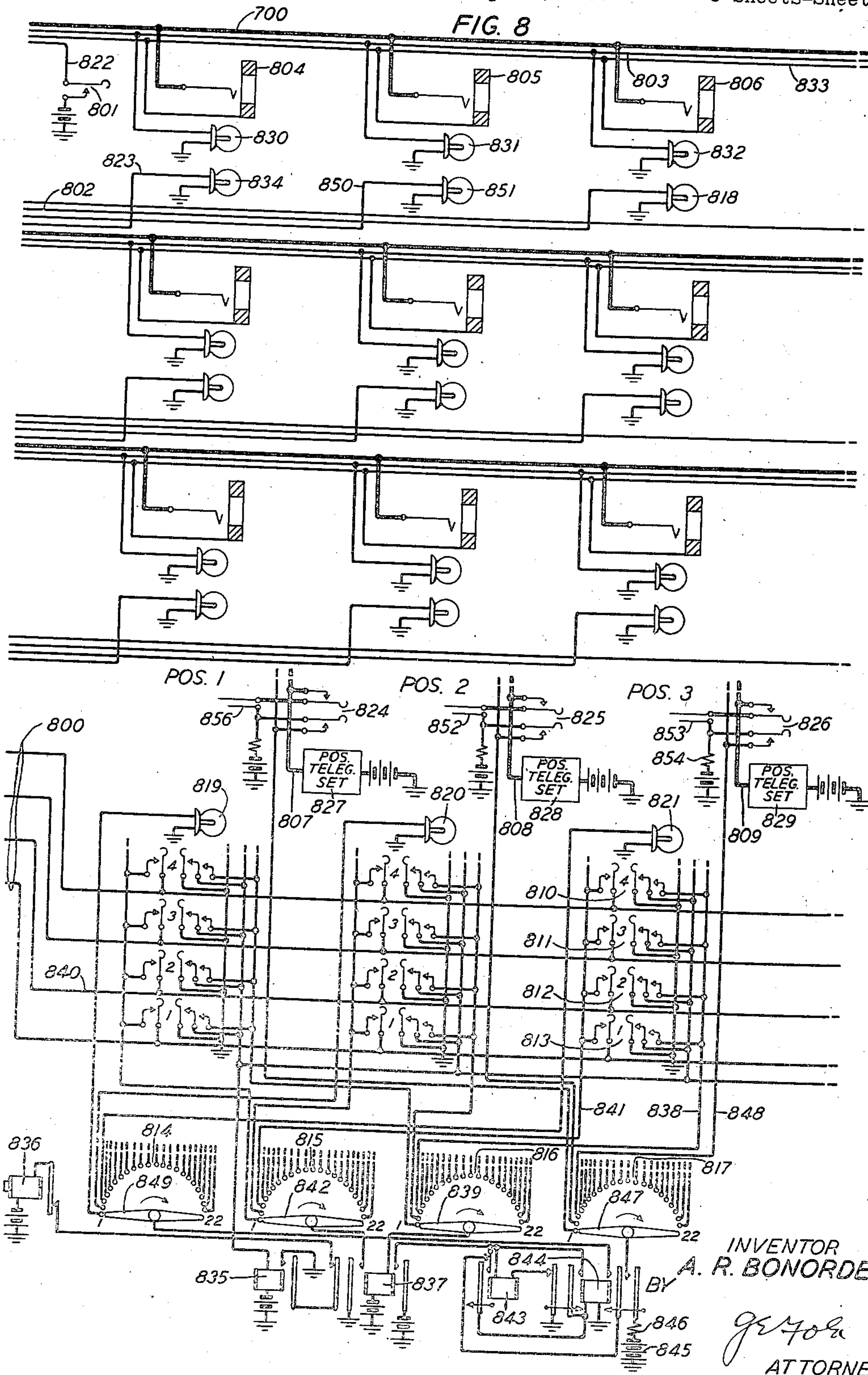
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TELEGRAPH SWITCHBOARD SWITCHING SYSTEM

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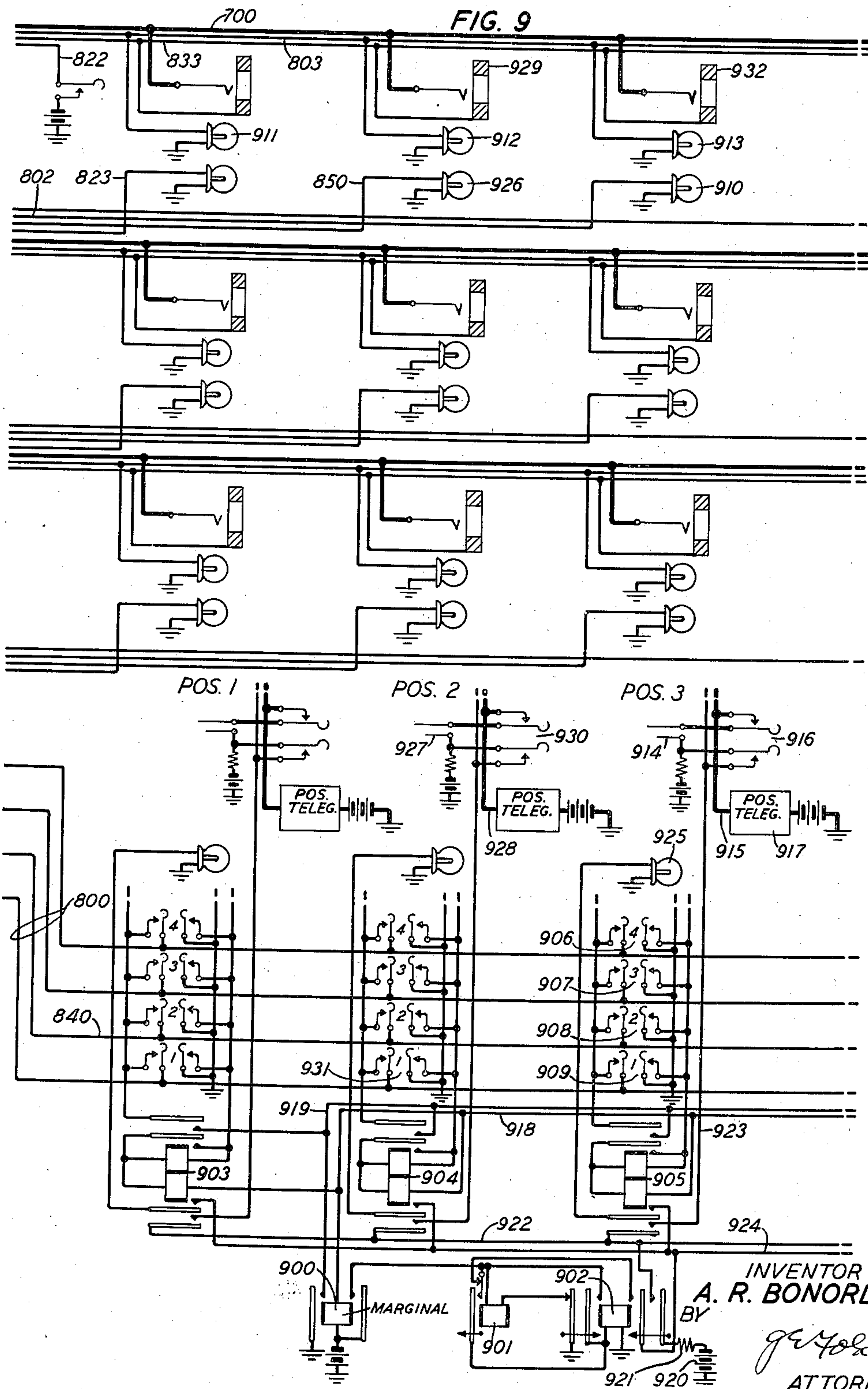
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TELEGRAPH SWITCHBOARD SWITCHING SYSTEM

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UNITED STATES PATENT OFFICE

2,139,799

TELEGRAPH SWITCHBOARD SWITCHING SYSTEM

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pany, a corporation of New York

Application August 26, 1936, Serial No. 98,055

7 Claims. (Cl. 178-2)

This invention relates to communication systems and more particularly to supervising and maintaining private, or order, wire service over intercity communication trunk circuits between test board attendants located in different cities.

An object of the invention is to permit an attendant at a test board or switchboard in one locality to be connected with any one of a plurality of attendants at a test board or switchboard in a different locality.

It is essential in test best operation in communication systems for attendants at two different localities, having charge of a particular service at their respective switchboards, to obtain direct communication with each other and consequently it is desirable to have an arrangement which will facilitate certain direct communications or permit of an incoming call being rapidly transferred to an attendant responsible for a particular service. Heretofore in both toll and telephone practice the transfer of calls, received over certain trunks or line circuits, is possible to a very limited extent, that is the facilities at present permit the transfer to one or at the most two points in the office.

According to the present invention, the facilities provide for each position or section in a line of test board to become a potential transfer point and in the larger of said offices these facilities extend to arrangements for transferring a call to any one of a plurality of positions or sections. In other words an attendant at a multiple type of switchboard may upon receiving an incoming call over an intercity communication trunk circuit, transfer the incoming call signal to any particular one of a plurality of trunk lamps, each of which is located at a different position or section in the switchboard. The multiple type of switchboard may comprise two or more sections, each section having one or more operators' or attendants' positions.

A feature of the present invention is that it provides a more flexible arrangement than heretofore known in that an incoming call signal may be transferred to a signal lamp at any one of even more than twenty positions.

Another feature is that an incoming call signal may be transferred to a lamp at any one of a plurality of switchboard positions and then again transferred to another lamp at one of the other positions.

Still another feature is that the arrangement may provide by proper cross-connections, for any trunk circuit to have either a primary or a

secondary answering appearance at any position on the multiple type of switchboard.

Another feature is the provision of having a sequence circuit associated with the trunk circuits or the positional key-sets.

Another feature is the provision of recalling the attendant at a primary position after the signal has been transferred to another position and the attendant at the latter position has failed to answer.

Another feature is the provision of a transfer key so that for night operation all signals of different trunk circuits normally appearing at different primary positions may be caused to appear at some one position used as a night or light load position.

Description

A more complete understanding of the invention may be obtained from the accompanying drawings in which

Figures 1, 2 and 3, represent an arrangement of the invention, when interconnected in accordance with the block diagram Fig. 1A, wherein Figure 1 shows two-way communication lines and associated line equipment, Fig. 2 a sequence circuit and associated control circuit for transferring calls and Fig. 3 answering jacks and lamps, associated busy lamps and trunk transfer keys, cord circuits and position transfer keys, cord circuits and position transfer keys with associated equipment.

Figs. 4, 5 and 6 represent another arrangement of the invention, when interconnected in accordance with the block diagram Fig. 4A, wherein Fig. 4 shows two-way communication trunks and associated line equipment, Fig. 5 a control circuit for transferring calls and Fig. 6, answering jacks and lamps, associated busy lamps and trunk transfer keys, cord circuits, position transfer keys with associated equipment and position sequence circuit relays.

Figs. 7, 8 and 9 represent still another arrangement of the invention, when interconnected in accordance with the block diagram 7A, wherein Fig. 7 shows two way communication trunks and associated line equipment including a cross-bar switch and Fig. 8 shows answering jacks and lamps, busy lamps, position transfer keys, cord circuits and a control circuit consisting of a rotary stepping switch.

Fig. 9 is an alternative arrangement of Fig. 8, which uses a relay type control circuit.

Figures 1, 2 and 3

Referring to Figs. 1, 2 and 3, 100 is an inter-

office trunk, which terminates in jacks 300, 301 and 302 of positions 1, 2 and 3, respectively. Associated with each of these jacks are answering lamps 303, 304 and 305 and busy lamps 306, 307 and 308. The attendant at each position is provided with a teletypewriter cord circuit, conventionally represented at the respective positions by the boxes 317, 318 and 319, with which calls may be answered by plugging into the jack associated with the lighted answering lamp, or originated by plugging in and then operating the teletypewriter break key. It is to be understood that when communication is effected by manually operated Morse code signals, the cord will terminate in a sounder and telegraph sending key. Additional jacks, answering and busy lamps may be provided at additional positions, not shown. As shown in the drawings positions 1 and 3 are cross-connected by conductors 200, so that the associated answering lamps 303 and 305 are lighted on an incoming call, that is, positions 1 and 3 are primary answering positions. Position 2 is not thus cross-connected, its lamp 304 is lighted only on a transferred call, and is accordingly a secondary answering position. It is to be understood, however, that, by the proper cross-connection, any position in the switchboard line up may be arranged as either a primary or secondary answering position.

In order to transfer incoming calls from one position to another, trunk 100 is provided with a rotary type stepping switch having a stepping magnet 201, which causes the brush arms 202 and 203 to move around the contact banks, 204 and 205, respectively. Each terminal of bank 204 is connected to a conductor leading to an answering lamp at the respective positions whereby each lamp may be selectively lighted as required. Each contact of bank 205 is connected to a conductor to which ground is selectively connected by the operation of one of the positional transfer keys, as key 309, 310 or 311 of position 1. In effecting a transfer the position to which the call is to be transferred is identified by the key 309, 310, 311, etc. and the trunk is identified by the associated transfer key, such as key 312. In order to use a transfer trunk common to all positions, such as trunk 313, the conductors of which connect together similarly placed contacts of all the switch banks, a so-called sequence circuit is used. This consists of relays 207, 208, 209, 210, 211 and 212, which are arranged in a manner similar to the relays of an automatic listening, straightforward trunk system, which is well known in the telephone art. The aforesaid sequence circuit functions so that the transfer trunk 313 is available to only one trunk at a time thereby making it unnecessary to bring a separate conductor from each key to the contacts of bank 203, and the contacts of similar banks associated with trunks 101 and 102. Another feature of the sequence circuit is the arrangement whereby calls awaiting transfer are handled progressively through the sequence.

In the description before given, particular reference was made to the trunk 100 and its associated apparatus. A similar description also applies to the other trunks, 101 and 102. A more complete understanding of the operation of the invention may be obtained from the following detailed description.

Let it be assumed that an attendant at a distant point desires to communicate over trunk 100 with an attendant at the secondary answering position, position 2 of Figure 3. To initiate a call

the circuit of trunk 100 is opened momentarily which causes the momentary release of line relay 103. If the line is kept open sufficiently long, relay 107 operates and brings in a line signal as will appear from the hereinafter given description. The release of relay 103 closes a circuit from battery through the right back contacts of relay 106, winding of slow releasing relay 105, closed contacts of relay 103 to ground on the right inner back contacts of relay 104. Relay 105 in operating closes a circuit from the ground on its lower winding terminal through its operated contacts and the winding of slow operating relay 106 to battery. After an interval relay 106 operates, if relay 103 has not reoperated, and in operating opens the operating circuit of slow releasing relay 105, which after an interval releases and closes a circuit from ground on its winding through its back contacts, momentarily operated left contacts of relay 106 and winding of relay 107 to battery. Relay 107 operates and locks through its left contacts to ground on the right inner back contacts of relay 104. If, after relay 106 has operated, relay 103 has reoperated, then relay 105 holds operated in a circuit from battery through the winding of relay 106, operated contacts of relay 105, winding of relay 105, right operated front contacts of relay 106, and resistance 108 to ground. Under this condition, relay 106 releases and relay 107 does not operate. It is seen therefore that the line relay 107 will respond only to an open interval of definite minimum duration, and not too short irregular openings even though they follow each other closely, thereby preventing false line signals.

When relay 107 operated it connected battery, with its right outermost and middle contacts, to conductors 109 which are cross-connected by conductors 200 to conductors 314 and 315. Answering lamps 303 and 305 of positions 1 and 3, respectively, are simultaneously lighted. Relay 107 also connects battery with its right innermost contacts to conductor 316 thereby lighting the busy lamps at all positions. Attendants at positions 1 and 3 respond to the lighted lamps 303 and 305 with cord circuits 317 and 319. Assuming that the attendant at position 1 plugs into jack 300 before the attendant at position 3 plugs into jack 302, sleeve relay 104 is operated in a circuit from battery through its winding over conductor 320 and through the uppermost operated contacts of jack 300 to ground. Relay 104 in operating disconnects ground with its inner right back contacts from conductor 111, thereby releasing relay 107 and extinguishing the answering lamps 303 and 305. The attendant at position 3, observing that lamp 305 is extinguished knows that the call is being handled at another position and accordingly makes no further effort to answer the call. Relay 107 in releasing also disconnects battery with its right innermost contacts from conductor 316, but relay 104 in operating reconnects battery thereto with its left innermost contacts, thereby maintaining the lighted condition of the busy lamps at all positions. Relay 104 in operating also closes through with its contacts 113 the lower conductor of trunk 100 to lower conductor of trunk 114 and with contacts 112 disconnects the winding of relay 103. Contacts 113 are arranged to make before contacts 112 break, thereby maintaining without interruption the continuity of the line.

When the plug of cord circuit 317 is inserted

into jack 300, the attendant of position 1 is in telegraphic communication over the tip and sleeve conductors of jack 300, trunks 114 and 100 with the distant attendant. Assuming that, as before stated, that the call is to be transferred to the secondary position 2, the attendant of position 1 will upon being requested to effect the transfer, now operates momentarily the key 312 associated with jack 300, thereby closing a circuit for operating relay 110, which is traced from battery through the right contacts of relay 115, winding of relay 110, over conductor 321, through contacts of key 312 and contacts 322 of jack 300 to ground. Relay 110 in operating locks through its left contacts to ground on the right inner front contacts of relay 104 and with its right middle contacts closes a circuit from ground over conductor 116 to battery 215 through the winding of the sequence circuit relay 207, which operates. If at this time no other trunk—as 101 or 102—is being transferred by an attendant at another position, relays 209 and 211 are not operated and consequently a circuit is closed for operating relay 208 associated in the sequence circuit with relay 207. This circuit may be traced from ground 238 on the back contacts of relay 213 through the winding of relay 214, (which also operates for a purpose hereinafter explained), back contacts of relays 211 and 209, right front contacts of relay 207 and winding of relay 208 to battery. If, however, another trunk at this time is being transferred either relay 209 or 211 is operated and the circuit before traced for operating relay 208 is open at the back contacts of relay 209 or 211. If relay 209 is operated, its winding is connected to battery 215 through the left break contacts of relay 208; if relay 211 is operated then its winding is connected to battery 215 through left break contacts of both relays 210 and 208.

A general description of the operation of the sequence circuit, which as before stated is used in the telephone art for straightforward trunking will now be given. Relay 211 may be said to be in the first, relay 209 in an intermediate and relay 207 in the last or highest numbered position in the sequence circuit chain. If relays 209 and 210 are operated, and lines are awaiting service in the last and first positions, relay 207 is operated, but relay 211 is not operated, since its operating path is disconnected by the left inner break contacts of relay 210. When relay 209 releases conductor 240 is transferred from the winding of relay 210 to conductor 239 by the continuity contacts of relay 209, thereby holding relay 214 operated through the right make contacts of relay 207 and the winding of relay 208, which now operates. Relay 211 does not operate since its circuit is opened by the left inner break contacts of relay 208. When relay 207 releases, releasing relay 208, the circuit through relay 214 is opened and this relay releases, releasing in turn slow releasing relay 213, which after an interval longer than the release time of relay 208 connects ground 238. During this open interval with relay 208 released, relay 211 and also relay 209, if this relay is again awaiting operation, now operate. Relay 211, however, disconnects conductor 240, so that relay 212, and not relay 210 or 208, operates. It thus appears that lines awaiting connection are served by the sequence circuit sequentially in accordance with their numbered position in the sequence, and not in accordance with the order of their call for service.

With relays 110, 207 and 208 operated as before

described, a circuit is closed for operating relay 334, which circuit may be traced from battery through the winding of marginal relay 216, over conductor 217, through left outer make contacts of relay 208, left contacts of relay 207, over conductor 233, right innermost contacts of relay 110, over conductor 323, through contacts 324 of jack 300, over conductor 325, through left and right windings of relay 334 to ground. Relay 334 operates, but marginal relay 216, however, does not operate at this time. Relay 334 in operating closes an obvious circuit through lamp 326, which is lighted indicating to the attendant that the circuit is now ready for the operation of the position transfer key. To transfer to position 2, key 310 is accordingly operated. If key 310 should be operated prematurely, that is, before lamp 326 is lighted, then a circuit is closed from ground, through right contact of key 310, back contacts of relay 334 (which has not operated) to battery through lamp 327, which is lighted indicating that the circuits are not ready to effect the desired transfer, either because of failure to operate the transfer key 312, or the non-availability of the sequence circuit at this moment.

In order to assist in differentiating clearly between the significance of the two lamps, lamp 326 may be provided with a white, and lamp 327 with a red cap. On operating key 310, assuming that relay 334 is operated, a circuit is closed from ground on its left contacts through the left contacts of key 310, over conductor 328 to the second terminals of the hunting contact banks 205, 206 and 218. In the drawings all brush arms are shown resting on the first contact terminals. It is to be understood, however, that the brush arms may rest normally on any contact terminal, since after a selection they remain on the selected terminal. The operation of key 310 with its right contacts connects a ground to the right inner front contacts of relay 334, thereby short-circuiting the right or high resistance winding of relay 334, which is connected to the said front contacts. Relay 334 continues to hold through its winding. The resistance in the circuit of marginal relay 216, is reduced and it now operates and closes a circuit from ground through the left back contacts of relay 219 and winding of slow releasing relay 220 to battery. Relay 220 operates and closes a circuit from ground through its contacts 221 and 222, back contacts of relay 223, right inner break contacts of relay 219, over conductor 224, right innermost contacts of relay 208, over conductor 225, right outermost contacts of relay 110, over conductor 226 and through the self interrupting contacts and winding of rotary stepping magnet 201 to battery. The brush arms 202 and 203 are now stepped around the contact banks 204 and 205 in the direction of the arrows respectively until the second terminal from the top is reached, which terminal is connected to the grounded conductor 328. When this terminal is reached a circuit is closed for operating relay 223 which is traced from battery through the winding of relay 223, over conductor 227 through the right outermost contacts of relay 208, brush arm 203, second terminal of bank 205, over conductor 328, through left operated contacts of key 310 and relay 334 to ground. Relay 223 in operating closes a circuit from ground through contacts 221 and 222 of relay 220, front contacts of relay 223, and winding of relay 219 to battery. Relay 223 also opens the previously traced operating path of selector magnet 201 which stops the rotation of

the brush arms leaving them on the second terminals, or contacts. Relay 219 operates and closes a circuit for holding itself and relay 220, which is traced from battery through the winding of relay 220, left front contacts of relay 219, front contacts of relay 223, and contacts 221 and 222 of relay 220 to ground. Relay 220 is slow in releasing and holds over the momentary open period while the left contacts of relay 219 are operating. Relay 219 in operating also opens the operating circuit for magnet 201, so that the subsequent release of relay 223 will not again start the selector. Relay 219 in operating also closes a circuit from ground through contacts 221 of relay 220, right outer contacts of relay 219, over conductor 228, right middle contacts of relay 208, over conductor 230 and through winding of relay 115 to battery.

If, as a result of a previous selection, brush arms 202 and 203 had been found resting on the second terminals of their associated banks, then relay 223 would have operated immediately and there would have been no switch movement whatever. Relay 115 operates and locks through its left inner contacts to ground on the right outer front contacts of sleeve relay 104, and with its right contacts opens the circuit of the winding of relay 110, which releases. Relay 110 in releasing, opens the circuit of sequence relay 207 which releases, in return releasing relay 208. The circuits of relays 216, 223 and 334, before traced, are now opened and these relays release. The release of relay 223 releases relays 219 and 220. When relay 334 releases, the selector lamp 326 is extinguished and the disconnect lamp 327 is lighted, which indicates to the attendant of position 1 that the transfer has been effected and that key 310 may now be released. The plug of the teletypewriter cord circuit 317 should now be withdrawn from jack 300, which opens its uppermost contacts releasing sleeve relay 104, which effects the operation of relay 117 in a circuit from battery through the winding of relay 117, left outer operated contacts of relay 115 to ground on the right outer back contacts of relay 104. The locking circuit for relay 115, through its left inner contacts is opened by the release of relay 104, but relay 115 is slightly slow in releasing so that relay 117 has time to operate the lock through its right contacts to the ground on conductor 118, before relay 115 releases. Relay 117 in operating connects battery through its left inner contacts to conductor 316 thereby maintaining the lighting of the busy lamps at all positions, and with its left outer contacts connects battery to conductor 229, which is extended over brush arm 202, second terminal of bank 204, conductor 329 and through lamp 304 to ground. Lamp 304 is lighted and in response thereto the attendant at position 2 inserts the plug of cord circuit 318 into jack 301, thereby connecting with trunk 114 through the tip and sleeve conductors. When the uppermost contacts of jack 301 connect ground to conductor 320, sleeve relay 104 is operated again, removing ground from conductor 118 releasing relay 117, which disconnects battery from conductor 229, thereby extinguishing lamp 304 at position 2. The operation of relay 104 connects battery with its left innermost contacts to conductor 316, thereby maintaining the lighting of the busy lamps when relay 117 disconnects battery with its left inner contacts.

The hereinbefore given discussion described how an incoming call was answered at primary position 1 and was then transferred to second-

ary position 2. In accordance with a feature of the invention, the attendant at position 2 may now retransfer the call, if required, to any other position in the switchboard line up, in the same manner as was described for the transfer of the original call. If for instance a transfer to position 3 is required, transfer key 330 is operated and then position key 331. After the operation of relay 332, ground is connected to conductor 333, through the left operated contacts of key 331, grounding thereby the third terminal of bank 205. The invention now functions as previously described in connection with the transfer of a call from position 1 to position 2. Brush arms 202 and 203 stop on the third terminal of banks 204, and 205, respectively. When the plug of cord circuit 318 is withdrawn from jack 301, relay 104 releases and relay 117 operates, lighting lamp 305 at position 3 over conductors 229 and 314 through brush arm 202 and third terminal of bank 204.

The operation of the invention has been described for an incoming call. It may also be used for outgoing calls. The attendant at position 2, for instance, may originate a call by plugging into jack 301, thereby operating sleeve relay 104 over conductor 320. Relay 104 in operating connects battery with its left innermost contacts to conductor 316, lighting the busy lamps at all positions. The attendant at the distant end of the line is signaled by the operation of the break key of the teletypewriter or by opening the telegraph key of cord circuit 318. If after communication has been thus established, it is desired to transfer the connection to another position, this may be done in the same manner as described in connection with an incoming call.

The invention has been described using as a basis trunk 100, which is associated with relays 207 and 208, which are in the last position of the sequence circuit chain. The invention functions in a similar manner for trunks 101 and 102, which are in the second and first positions, respectively. Relay 209, however, does not operate after its associated relay 119 operates, unless relay 208 is normal at the time, so that battery 215 is available through the left inner contacts of relay 208 over conductor 230. Similarly relay 211, does not operate immediately, when its associated relay 120 operates, unless relays 208 and 210 are both not operated, thereby making battery 215 available through the left inner contacts of relays 208 and 210, over conductors 230 and 231. Although only three trunks are shown it is to be understood that other trunks may be added. Additional pairs of sequence relays may be connected in the same manner as are relays 209 and 210, 211 and 212. The additional relays should be connected to the vertical extensions of conductors 232, 217, 227, 228 and 224 in which case battery 215 is always associated with the last relay in the sequence.

Figures 4, 5 and 6

Referring now to the arrangement of the invention shown by Figs. 4, 5 and 6, 400 is an inter-office trunk which terminates on jacks 600, 601 and 602 of positions 1, 2 and 3, respectively. Associated with these jacks are answering lamps 603, 604 and 605 and busy lamps 606, 607 and 608. The attendant at each position is provided with a teletypewriter or manual telegraph cord circuit, conventionally represented at the respective positions by the boxes 620, 621 and 622, with which calls may be answered by plugging into the

jack associated with the lighted answering lamp, or originated by plugging in and then operating the teletypewriter break key or holding the telegraph sending key open momentarily. Additional jacks, answering and busy lamps may be provided at additional positions, not shown. As shown in the drawings, position 3 is cross-connected by conductor 509, so that the associated answering lamp 605 is lighted on an incoming call, that is, position 3 is a primary answering position. Position 2 is normally not thus connected, its lamp 604 is lighted only on a transferred call, and is accordingly a secondary answering position. Position 1 may be either a primary or secondary position. When the night key 609 of trunk 400, and all other similar night keys are operated, then position 1 is cross-connected so that all incoming calls also effect the lighting of the line lamps of position 1, which is then a primary position. When key 609 and the other night keys are not operated, then the cross-connections are not effective, the answering lamps light only on transferred calls, and position 1 is then a secondary position. By the proper cross-connection any position in the switchboard line up may be arranged as either a primary or answering position.

In order to transfer calls from one position to another, trunk 400 is provided with a rotary type stepping switch, which is similar to that shown in Fig. 2. Each terminal of bank 505 is connected to a conductor leading to an answering lamp at the respective positions, whereby each lamp may be selectively lighted as required. Each contact of bank 506 is connected to a conductor, to which ground is selectively connected by one of the positional transfer keys, such as key 610, 611 or 612 of position 1. In effecting a transfer the position to which the call is to be transferred is identified by the key 610, 611 or 612, etc., and the trunk is identified by the associated transfer key, such as key 617, which is an arrangement like that of Figs. 1, 2 and 3. In order to make use of a simple transfer trunk such as 616, which is similar to the arrangement of Figs. 2 and 3; a sequence circuit is provided consisting of a pair of relays such as 614 and 615, interconnected as shown for each position. With this arrangement, the transfer facilities of only one position are available at one time, thereby avoiding possible interference due to several attendants at different positions attempting to transfer calls simultaneously. This arrangement differs from that of Figs. 1, 2 and 3, since in the latter the sequence circuit was associated with the individual trunks and not with the positional transfer keys. Where there is a comparatively large number of trunks with only a few switchboard positions the arrangement of Figs. 4, 5 and 6 may be more desirable than that of Figs. 1, 2 and 3, since fewer sequence relays may be required. There is a possibility, however, that in the arrangement of Figs. 1, 2 and 3 that the attendant at one position may attempt to transfer two trunks simultaneously. A description of the means whereby interference is avoided in this case is given hereinafter under Figs. 4, 5 and 6.

Figures 4, 5 and 6

A more complete understanding of the operation of the arrangement of Figs. 4, 5 and 6 may be obtained from the following discussion which follows the progress of a call. Let it be assumed that an attendant at a distant switchboard desires to communicate over line 400 with the at-

tendant at the secondary position 2. When the normally closed circuit of line 400 is momentarily opened relay 403 releases and closes a circuit for operating relay 404, which is traced from battery on the right back contacts of relay 405 through the winding of slow releasing relay 404, closed break contacts of relay 403 to ground on the right inner break contacts of sleeve relay 406. Relay 404 in operating closes a circuit for operating relay 405, which is traced from the operating ground on the lower terminal of relay 404 through front contacts of relay 404 and winding of relay 405 to battery. After an interval, relay 405 which is slow-to-operate, operates and opens with its right back contacts, the operating circuit for relay 404. It also closes with its left contacts a circuit from battery through the winding of relay 407 to the back contacts of relay 404. When this relay releases after an interval, if the contacts of relay 403 still remain closed, the operating ground on the winding of relay 404 operates relay 407, which locks over conductor 408 to ground on the right inner back contacts of relay 406. This arrangement of relays 403, 404, 405, and 407 is identical with that of relays 103, 105, 106 and 107 of Fig. 1 and functions in a similar manner. Relay 407 in operating connects battery with its right outer contacts to conductor 409, thence over cross-connection conductor 500 and conductor 623 to ground through lamp 605, which is lighted, and with its middle right contacts connects battery over conductor 624 to the contacts of night key 609. When this key is operated, which is the case when position 1 is operated as a night position, then battery is extended also over conductor 625, cross-connection conductor 501, and conductor 626 to ground through lamp 603 which lights.

Relay 407 also, with its right innermost contacts connects battery to conductor 628, thereby lighting busy lamps 606, 607 and 608. The attendant at position 3, responds with the teletypewriter cord circuit 622 and sleeve relay 406 operates over conductor 627 to ground through the uppermost local contacts of jack 602, and in operating removes ground from conductor 408, releasing relay 407 and extinguishing lamp 605. Relay 406 in operating connects battery with its left innermost contacts to conductor 628, which maintains the lighting of the busy lamps 606, 607 and 608, after battery has been removed by the release of relay 407. Having been informed that the call should be transferred to position 2, the attendant at position 3 first operates the transfer key 629 associated with jack 602 and thereby closes a circuit for operating relay 410 which is traced from battery through the winding of relay 410, over conductor 630, through contacts of key 629 to ground through the operated contacts 631 of jack 602. The positional transfer key 650 is then operated and a circuit is closed from battery 638 through the winding of sequence circuit relay 632, lower back contacts of marginal relay 633 to ground through the right contacts of key 630. Relay 632 operates and if neither relay 614 or 634 is operated then a circuit is closed from battery through the winding of sequence relay 635, lower front contacts of relay 632, lower back contacts of relays 634 and 614, over conductor 636, through winding of relay 507 to ground on the break contacts of relay 508. Relays 635 and 507 operate. Relay 507 in operating closes an obvious circuit through the winding of slow releasing relay 508 and locks to ground on its own contacts. Relay 508 operates and disconnects

the original operating ground. This arrangement of sequence relays operates in similar manner to that of Fig. 2 discussed before in detail. Relay 635 in operating connects ground with its upper outer contacts to conductor 637; thence this ground is connected by the left operated contacts of key 630 to conductor 631, which terminates on the second terminal of hunting contact bank 506, thereby marking position 2 to receive the transferred call. Relay 635 disconnects, with its upper inner break contacts, battery 638 from conductor 639, thereby making this battery unavailable at this time for relays 634 and 614. Relay 635 also closes a circuit which is traced from ground through the upper winding of marginal relay 633, upper operated contacts of relay 632, lower inner contacts of relay 635, over conductor 640, and through the serially connected left and right windings of relay 509 to battery. Relay 509 operates in this circuit, but marginal relay 633 does not operate at this time. Relay 509 closes a circuit from ground through the left back contacts of relay 510 and winding of relay 511 to battery. Relay 511 operates and closes a circuit which is traced from battery through the left back contacts and right winding of marginal relay 512, operated left contacts of relay 511, over conductor 641, through lower outer operated contacts of relay 635, over conductor 649 operated contacts 643 of jack 602, over conductor 644, through right outer break contacts of relay 411, over conductor 513, through winding of marginal relay 514, over conductor 515 to ground on the right outer operated make contacts of relay 410. Relay 514 operates but relay 512 does not operate at this time. Relay 514 in operating closes a circuit from battery through winding and break contacts of stepping magnet 502, right outer contacts of relay 514, over conductor 516, right inner break contacts of relay 510, back contacts of relay 517, operated contacts 518 and 519 of relay 511, to ground on the break contacts of relay 512. The brush arms 503 and 504 are now rotated in the direction of the arrows until contact 2 is reached. A circuit is then closed from battery through the winding of relay 517, over conductor 520, through left operated contacts of relay 514, over conductor 521, brush arm 504, second contact of bank 506, over conductor 631, through left operated contacts of key 650 to ground on operated upper, outer contacts of relay 635. Relay 517 operates and opens the operating circuit, hereinbefore traced, of magnet 502, thereby causing brush arms 503 and 504 to stop on the second terminals of banks 505 and 506. Relay 517 in operating closes a circuit for operating relay 510 which may be traced from battery through the winding of relay 510, front contacts of relay 517, operated contacts 518 and 519 of relay 511 to ground on the break contacts of relay 512. Relay 510 locks with its left inner front contacts to ground on the contacts of relay 509, before relay 511, which is slow in releasing, releases due to the opening of its circuit by the left back contacts of relay 510. Relay 510 also closes a circuit from ground on the contacts of relay 512, through contacts 518 and 519 of relay 511, also before this relay releases, right outer contacts of relay 510, over conductor 522, through right inner operated contacts of relay 514, over conductor 523 and left winding of relay 411 to battery. Relay 411 operates and locks through its right winding and right inner contacts to ground on the left outer operated contacts of relay 410, and with left inner

contacts connects battery to conductor 628 to maintain the busy lamps lighted, when sleeve relay 406 subsequently releases as hereinafter described. Relay 411 also opens with its right outer break contacts the operating circuit for relay 514, which releases.

When relay 511 releases as hereinbefore described it connects battery through its right outer break contacts and the left operated outer make contacts of relay 510 to the common terminal of the windings of relay 509, which is equivalent to short circuiting the right winding of relay 509. Relay 509, however, still holds through its left winding and, due to the decreased resistance, marginal relay 633 now operates and closes an obvious circuit to battery through the transfer lamp 613, which lights. Relay 633 locks through its lower winding and front contacts to ground on the right contacts of key 650 and also with its lower contacts opens the circuit of sequence relay 632, which releases and in turn releases relay 635, thus immediately freeing the sequence circuit for the use of attendants at other positions even though the attendant at position 3 continues dilatorily to hold key 650 operated. After observing the lighted lamp 613, the attendant releases key 650, which releases relay 633, extinguishing lamp 613. On withdrawing the plug of cord circuit 622 from jack 602 sleeve relay 406 releases, releasing relay 410. Relay 406 in releasing connects ground through its right outer back contacts and through the right inner contacts and winding of relay 411 to battery. This prevents relay 411 from releasing when the ground on the left outer contacts of relay 410 is disconnected. Relay 406 in releasing also reconnects to the conductors of trunk 400, the winding of line relay 403, which reoperates. The release of relay 410 closes a circuit from battery through the right break contacts of relay 410, left outer operated contacts of relay 411, over conductor 524, brush arm 503, second terminal of bank 505, over conductor 642 and to ground through lamp 604, which lights. In response to the lighted lamp, the attendant at position 2, inserts the plug of cord circuit 621 into jack 601, and connects ground with the uppermost contacts of jack 601 to conductor 627, thereby operating sleeve relay 406, which removes ground with its right outermost back contacts from the right winding of relay 411, which releases, extinguishing lamp 604. The busy lamps, at all positions, however, are maintained operated, by battery connected to conductor 628, by the left innermost contacts of relay 406. If the attendant at position 2 should delay in answering, the attendant at the distant office may recall the attendant at position 3 as in the case of the original call, relays 403, 404, 405 and 407 functioning as before and effecting the lighting of lamp 605 at position 3. If the attendant at position 2 should find in communicating with the distant attendant that the call should be transferred to some other position, the transfer may be made in the manner hereinbefore described for the original call. When the plug of the cord circuit 621 is withdrawn from jack 601 relay 406 releases and the winding of relay 403 is reconnected to trunk 400 without opening the circuit, by means of the left continuity springs of relay 406. Relay 403 reoperates and all apparatus is now ready for another call.

Another feature pertaining to the arrangement of Figs. 4, 5 and 6 will now be discussed whereby the possibility of interference due to the simul-

taneous transfer of calls from the same position is avoided. Let it be assumed that a call over trunk 400 has been answered at position 3 and that the trunk transfer key 629 has been operated all as hereinbefore described. If at this moment a call comes in over line 401, associated lamp 653 lights and the attendant may inadvertently insert the plug of another cord circuit into jack 648 before completing the transfer of the call on trunk 400. It may happen now that the attendant is requested to transfer the call on trunk 401, and forgetting that the transfer of the call on trunk 400 has not been completed, may operate transfer key 645, effecting the operation of relay 413 in the same manner as the operation of relay 410 was previously effected. When a positional transfer key of position 3, key 650 for instance, is now operated, the circuit hereinbefore traced over conductor 649 now branches also through contacts 646 of jack 648, over conductor 647, through outer right break contacts of relay 412, over conductor 526, through winding of relay 525, over conductor 527 to ground on the right outer operated contacts of relay 413. Marginal relay 512 now operates in this circuit, but neither marginal relay 514 nor marginal relay 525 operates. Relay 512 in operating opens with its left contacts the short circuit around its left winding thereby inserting the resistance of its left winding, and with its right contacts disconnects ground from contacts 518 and 519 of relay 511. Under this condition it is clear that the rotary switches controlled by magnets 502 and 528 do not operate. Marginal relay 633 does not operate and lamp 613 does not light. The failure of lamp 613 to light after key 630 has been held operated for a period of time more than is ordinarily sufficient to effect a transfer, is an indication that a simultaneous double transfer has been improperly attempted. The attendant will accordingly release key 650, causing relays 632, 635, 509, 511 and 512 to release. The attendant will also remove momentarily the cord circuit plug from one of the jacks, say jack 648, thereby releasing relay 413. When the attendant again operates key 650 sequence relays 632 and 635 reoperate and the desired transfer of the call on trunk 400 to position 2 is now effected, and lamp 613 lights as hereinbefore described.

The preceding description has been based on the operation of trunk 400, with an incoming call answered at position 3 and transferred to position 2. The operation with the other trunks 401 and 402 is similar, and at other positions the sequence circuit functions in like manner.

Figures 7, 8 and 9

Referring to the other arrangement of the invention disclosed by Figs 7, 8 and 9, the combination of Fig. 7 with Fig. 8 will now be discussed. In Fig. 7 are shown three intercity telegraphic communication trunks 700, 701, and 702, which are arranged to cooperate with a cross-bar switch CB which is of the same general construction as that described in Patent No. 2,021,329, issued November 19, 1935 to J. N. Reynolds, from which patent a complete description may be obtained. The function of switch CB is to cooperate over transfer trunk 800 with positional transfer keys shown in Fig. 8 in order to transfer calls to various positions in a telegraphic switchboard line up. The switch CB is shown with trunks 700, 701 and 702 connected to cooperate with verticals 1, 2 and 10 respectively. Intervening verticals 3, 4, 5, 6, 7 and 8 are omitted as being unnecessary for the purpose of this description, and are

symbolized by vertical 9 which is shown unconnected. Only four horizontals are shown, each of which represents positions respectively 1, 2, 3 of Fig. 8, and position 4, not shown. Horizontals 5, 6, 7, 8, 9 and 10 are not shown since these are not necessary in describing the invention. By means of the switch CB ten trunks as 700, 701, 702, etc. may be served, and transferred to any one of ten positions. By using two switches any one of twenty trunks may be transferred to any one of ten positions, or alternatively, any one of ten trunks may be transferred to any one of twenty positions. Furthermore, by using an N number of cross-bar switches connected together horizontally there is provided space for ten times N number of trunk circuits to ten positions; by using M number of cross-bar switches connected together vertically there is provided space for ten trunk circuits to ten times M positions; and by using N number of cross-bar switches connected together horizontally and M number of cross-bar switches connected together vertically there is provided by the joint arrangement ten times N number of trunk circuits to ten times M number of positions, N and M being any desired numbers.

When the attendant at the distant office originates a call on one of the trunks, say trunk 700, by sending a long space signal, trunk 700 is grounded and relays 703, 704 and 705 function so as to operate the lamp 834 at position 1 of Fig. 8, assuming that the night key 801 is operated so that this position is now a primary answering position. Also the lamp 818 at position 3 is lighted over conductor 802, and the busy lamps at all positions are lighted over conductor 803. This is in accordance with the cross-connections 706 and 707. The answering lamps for trunk 700 at position 1, when key 801 is not operated and at position 2 are lighted only on transferred calls. Any position may be cross-connected so as to function as either a primary or secondary position. In response to a lighted answering lamp associated with trunk 700, the attendants plug into the answering jacks 804, 805 or 806, with the telegraph cord circuits 807, 808 or 809, thereby extinguishing the lighted answering lamps. In order to transfer a call from one position to another, a position transfer key as key 810, 811, 812 or 813, corresponding to the position to which the transfer is to be made, is operated. This causes a stepping switch type of control circuit, shown at the bottom of Fig. 8, to function and to associate itself with the position from which the transfer is to be made, provided the control circuit is not then in use at some other position. In operating, the control circuit causes a selecting magnet 708, 709, 710 or 711, corresponding to the position to which the transfer is to be made, to be energized and then also a holding magnet 712, 714 or 715, corresponding to the trunk 700, 701 or 702 which is to be transferred. The contacts of switch CB, corresponding to the intersection of the operated holding and selecting magnet are now closed. When the transfer apparatus has completed its operation, a signal is given to the attendant by the lighting of the positional release lamp 819, 820 or 821. The operated position key is then released, and when the plug of the cord circuit, which was used to answer the call, is withdrawn from the answering jack, the lamp at the position to which the transfer is to be made is lighted. A more complete understanding of the operation of the arrangement of Figs. 7 and 8 may be obtained

by tracing the progress of a call as hereinafter described.

Let it be assumed that an attendant at a distant switchboard desires to initiate a call over the trunk 700 for the attendant who is located at position 2, which is accessible to trunk 700 only as a secondary answering position. When the conductor of trunk 700 is grounded due to the calling impulse from the distant end a circuit is closed through the left outer contacts of sleeve relay 716, winding of relay 703, to battery on the left back contacts of relay 704. Relay 703 operates and closes a circuit through the winding of relay 704, which is traced from battery on the left operated contacts of relay 703, through the winding of relay 704 and the left outer contacts to the conductor of line 700. Relay 704 operates and closes a locking circuit for itself from battery through its left operated contacts and winding through the left break contacts of sleeve relay 716 to the trunk conductor, and also with its left back contacts opens the circuit of relay 703, which releases. Relay 703 in releasing closes a circuit from battery through the winding of relay 705, right break contacts of relay 703 to ground on the right operated contacts of relay 704. Relay 704 is made slow-to-operate and relay 703 slow-to-release, which arrangement necessitates that the calling signal be maintained for an appreciable interval to assure the operation of relay 705 and accordingly safeguards the circuit against false signals, due to momentary line disturbances. When the calling pulse is terminated relay 704 releases. Relay 705 in operating locks through its right inner contacts to ground on the left inner contacts of sleeve relay 716; with its left outer front contacts it connects battery to conductor 717, thence through cross-connection 707 to conductor 802, which extends to position 3 at which the answering lamp 818 is lighted. Busy lamps 830, 831, 832 and busy lamps at other positions, not shown, are all lighted over conductor 803 from battery on the right outer contacts of relay 705. The attendant at position 3 responds by inserting the plug 853 of the telegraph cord circuit 809 into jack 806 and operating the locking cord circuit key 825, which connects with its upper contacts the position telegraph set 829 through the tip conductors of the plug 853 and jack 806 to the conductor of trunk 700. A circuit is also closed from battery through resistance 854, sleeve of plug 853 and jack 806, over conductor 833, through winding of relay 716 and right winding of marginal relay 719 to ground. Relay 716 operates but relay 719 does not operate at this time. Relay 716 in operating removes the calling-in signal relays 703 and 704 from the trunk 700 with its left outer contacts, and with its left inner contacts opens the locking circuit of relay 705, which releases, extinguishing the lamp 818.

The attendant at position 3 is now in telegraphic communication with the distant attendant. Should he be requested to transfer the call to position 2, which is in accordance with the previous assumption he will accordingly operate position transfer key 812, which is the key for transferring calls to position 2, closing a circuit from battery through the winding of relay 835 and the right contacts of key 812 to ground. Relay 835 in operating closes a circuit for operating the stepping magnet 836, which is traced from battery through the winding of magnet 836 and its interrupting contacts, left outer contacts

of relay 837 to ground on the contacts of relay 835. Key 812 through its right contacts also connects ground to conductor 838, which extends to contact terminal No. 3 of hunting bank 816, which terminal corresponds to position 3 at which the transfer is being effected. As indicated on the drawings other terminals corresponding to other positions, are numbered consecutively in the direction indicated by the arrow, which also indicates the direction of rotation of the brush arm 839.

When the circuit through the winding of stepping magnet 836 is closed as before described, brush arm 839 and the other brush arms of the switch are stepped around in the direction of the arrows until terminal No. 3 is reached. Ground on terminal No. 3 is reached. Ground on terminal No. 3 of hunting bank 816 connected as before described, now operates relay 837, which opens with its left outer contacts the circuit of stepping magnet 836, thereby preventing the further movement of the switch. A circuit is also closed for energizing selecting magnet 709 of the CB switch, which is traced from battery through the winding of magnet 709, over conductor 840, through left operated contacts of key 812, over conductor 841, through No. 3 contacts and brush arm 842 to ground on the left inner contacts of relay 837. Relay 837 also closes a circuit for operating relay 843, which is traced from battery on the right contacts of relay 837, through winding of relay 843 to ground on the left outer contacts of relay 844. Relay 843 in operating closes a circuit with its make contacts from battery on the right contacts of relay 837 to ground through the winding of slow operating relay 844, which locks with its left inner contacts to battery on the right contacts of relay 837. Relay 843 is designed to release slowly to assure that relay 844 locks up before its operating circuit is opened. Relay 844 is slow-to-operate to assure that relay 843 operates and its magnetic circuit is saturated before its operating circuit is opened and to assure a sufficient delay in energizing holding magnet 712, after selective magnet 709 is energized, as will be hereinafter described.

When relay 844 operates it closes a circuit from battery 845, through resistance 846 and its right outer contacts, brush arm 847, No. 3 contact terminal of bank 817, over conductor 848, through lower operated contacts of key 826, sleeve conductors of plug 853 and jack 806, over conductor 833, through winding of sleeve relay 716 and right winding of marginal relay 719 to ground. Battery 845 is of higher voltage than that of the battery connected to sleeve resistance 854 and relay 719 now operates and locks from battery through its left contacts and winding to ground on the right outer contacts of relay 716. Relay 719 with its right contacts connects ground over conductor 720 through winding of selective magnet 712, over conductor 721 to battery on the left back contacts of relay 705, which as before stated, released when relay 716 operated. Magnets 709 and 712 are now both operated, operating springs 722, which are located at the intersection of the vertical and horizontal corresponding respectively to magnets 712 and 709. Relay 844 operated also closes a circuit traceable from battery on the right contacts of relay 837, through back contacts of relay 843, right inner contacts of relay 844, brush arm 849 and contact No. 3 of bank 814 to ground through release lamp 821, which is lighted. The attendant at position 3 observing the lighted lamp 821, knows that the selection

has been completed and releases key 812 which releases magnet 709, making it immediately accessible to the control circuit. Relays 835, 837 and 844 also release and the control circuit is now ready for another selection at any position. Plug 853 is now removed from jack 806, which releases relays 716 and 719. Magnet 712 is held in a locking circuit through its left contacts which circuit is traced from ground on the right outer back contacts of relay 716 over conductor 723 left contacts and winding of magnet 712, over conductor 721 and left back contacts of relay 716 to battery. In order to maintain the circuit of magnet 712 continuously closed, ground is connected by the continuity contacts of relay 716, to conductor 723, before the locking circuit of relay 719 is opened when relay 716 releases. When relay 716 releases, battery on the right inner contacts of relay 716 is disconnected from conductor 803, but the battery on the left back contacts of relay 705 is extended over conductor 721, through right contacts of magnet 712, to conductor 803, thereby maintaining the lighting of the busy lamps. A circuit is also closed for lighting lamp 851 at position 2, which is traced from battery on the left back contacts of relay 719 over conductor 725, contacts 722 of switch CB over conductor 850 to ground through lamp 851.

The attendant at position 2 responds by inserting plug 852 of cord circuit 808 into jack 805, thereby operating relay 716. Magnet 712 releases due to the opening of its circuit at the right outer back contacts of relay 716, and lamp 851 is extinguished.

If, after the lamp 851 is lighted, the attendant at position 2 should delay his response the calling attendant may recall the attendant at position 3, by reoperating relay 705 as hereinbefore described, thereby relighting lamp 818.

In the description hereinbefore given position 3 was cross-connected as a primary, and position 2 as a secondary position. Position 1 is arranged regularly to operate as a secondary position, but when the key 801 is operated it functions as a "night" position or primary position at which all incoming calls for the switchboard are answered, all other positions at this time being unattended. Key 801 is associated with all trunks over conductor 822 and multiple conductor 726. When relay 705 is operated, as before described, battery is connected, through the contacts of key 801 over conductor 822, through left inner contacts of relay 705, over conductor 718, cross-connection 706, conductor 823 and through lamp 834 to ground, which is lighted. The operator at position 1 then answers by inserting plug 856 of cord circuit 807 into jack 804, the lamp 834 being extinguished by the operation of sleeve relay 716. Communication is established by operating cord circuit key 824.

Referring now to the alternative arrangement in which Fig. 7 cooperates with Fig. 9, trunks 700, 701 and 702 are associated with jack and lamp equipment in Fig. 9, identical with that of Fig. 8. Also, the cord circuits at each position are the same as in Fig. 8. However, in Fig. 9, instead of a stepping switch type of control circuit a relay circuit, consisting of common relays 900, 901, 902 and positional relays 903, 904 and 905 is used. When one of the positional transfer keys, as 906, 907, 908 or 909 is operated, the associated positional control relay is caused to operate, if the control circuit is not in use, and in cooperation with the common relays of the con-

trol circuit effects the operation of the apparatus of Fig. 7 over the conductors of the transfer trunk 800 in the same manner as before described in connection with Fig. 8. A more complete understanding of this arrangement of the invention may be obtained from the following detailed description.

Let it be assumed that a call over trunk 700 causes the apparatus of Fig. 7 to function as before described connecting battery to conductors 802 and 803 and in this case causing the lighting of answering lamp 910 and busy lamps 911, 912 and 913. The attendant at position 3 responds by inserting plug 914 of cord circuit 915 into jack 932. Lamp 910 is extinguished, and the busy lamps remain lighted, as before described. When cord circuit key 916 is operated, communication over trunk 700 is established. Assuming now that the attendant of position 3 is requested to transfer the call, as in the case of the arrangement of Figs. 7 and 8, to position 2, position transfer key 908 is accordingly operated, thereby closing a circuit from battery through the winding of relay 900, over conductor 918, through both windings of relay 905 in series to ground on the right operated contacts of key 908. If now relay 903, 904, or some similar relay at another position, not shown is not operated, relay 905 operates. A discussion of the means whereby the control circuit functions so as to avoid interference, when a simultaneous attempt to transfer a call is made is discussed hereinafter. Relay 905 with its upper inner contacts short circuits its high resistance upper winding, which so reduces the resistance of the circuit that relay 900 operates. Relay 905 continues to hold on its lower winding. Relay 900 operated closes a circuit from ground on its left contacts, over conductor 919, through upper outer make contacts of relay 905, left operated contacts of key 908, over conductor 840 and to battery through the winding of selecting magnet 709, which operates. Another circuit is closed from battery through the right contacts of relay 900, winding of relay 901 to ground on the left outer break contacts of relay 902. Relay 901 operates and operates relay 902 in a circuit from ground through the winding of relay 902, front contacts of relay 901 to battery on the operated right contacts of relay 900, to which relay 902 locks through its left inner contacts. Relay 902 releases slow release relay 901 and with its outer right contacts connects battery 920 through resistance 921 to conductor 922, through lower outer contacts of relay 905 to conductor 923. From conductor 923 battery 920 is extended through the lower operated contacts of cord circuit key 916 to the sleeve circuit of plug 914 and jack 932. Battery 920 is of higher voltage than that of the regular sleeve circuit battery hence marginal relay 719 operates as before described in connection with Fig. 8 and energizes hold magnet 712, closing contacts 722. Another circuit is closed when relay 901 eventually releases from battery on the right contacts of relay 900, break contact of relay 901 through right inner contacts of relay 902, over conductor 924, through lower inner contacts of relay 905 to ground through lamp 925, which is lighted, indicating to the attendant that the selection has been completed. Key 908 is now restored to normal which releases relays 900, 902 and 905 extinguishing lamp 925. Plug 914 is now withdrawn from jack 932 and lamp 926 at position 2 lights. The attendant at position 2 answers the call by inserting plug 927 of cord circuit 928 into jack

929 and operating cord circuit key 930. From this point, the description in connection with Fig. 7 and Fig. 8 applies.

The means whereby interference is avoided, if attendants at different positions attempt to transfer calls simultaneously will now be discussed. When key 908 was operated as before described it was assumed that the common control circuit was not then in use. Suppose, however, that the circuit being used at position 2, that the associated relay 904 is operated and the upper high resistance winding of relay 904 is short-circuited and connected to ground through the operated right contacts of key 931. Under this condition the two serially connected windings of relay 905 are shunted by the low resistance lower winding of relay 904. Relay 905 is marginal under this condition and does not operate. Consequently position 2 encounters no interference from position 3. If key 908 should be operated simultaneously with key 931 relays 904 and 905 would then operate together. If each relay should close its upper inner front contacts simultaneously and short-circuit its upper winding then the individual current flow through the respective lower windings of relays 904 and 905 would be so small that the relays would immediately release. If now one of the relays, say relay 904, should release before relay 905, then the low resistance shunt on the winding of relay 905 is removed and relay 905 holds, and at the same time shunts effectively the two serially connected windings of relay 904, which continues in the released condition.

If the attendant at position 2, to which position the call answered at position 3 was transferred, should be required to retransfer the call to some other position, this may be done in the case of both Figs. 8 and 9 in the same manner as in the case of an original call at a primary position.

The operation of the arrangement of Figs. 7, 8 and 9 has been discussed on the basis of calls incoming over trunks 700, 701 and 702. This arrangement, however, is equally well adapted to handle outgoing calls. To initiate a call an attendant plugs into the answering jack associated with the trunk over which the call is to be transmitted and operates the cord circuit key. By sending a spacing signal, i. e., grounding trunk 700 for a short period of time causes the signal at the distant end to operate.

What is claimed is:

1. In a manually operated switching system, a switchboard divided into a plurality of sections, a plurality of two-way trunk circuits for incoming and outgoing messages, a switching device associated with each of said trunk circuits, a plurality of auxiliary circuits connected in multiple to each of said switching devices and terminating at said switchboard, a primary signal lamp path and a plurality of secondary lamp paths associated to each of said auxiliary circuits and respectively having appearances at different sections of said switchboard, a lamp in each of said paths, a keyset at each section of said switchboard comprising keys for initiating the transfer of an incoming call signal to a lamp in any desired secondary lamp path, and switching means associated with each of said auxiliary circuits for automatically completing the transfer of a call signal incoming over any one of said trunk circuits and appearing at one of the sections of said switchboard, to any one of the other sections of said switchboard.

2. In a manually operated switching system, a switchboard divided into a plurality of sections, a plurality of two-way trunk circuits terminating in said switchboard, a plurality of auxiliary circuits associated with said trunk circuits terminating at each of said sections, a primary signal lamp path and a plurality of secondary lamp paths associated with each of said trunk circuits and respectively having appearances at different sections, a lamp in each of said paths, a keyset at each section comprising keys for initiating the transfer of an incoming call signal to a lamp in any desired secondary lamp path, switching means associated with each of said auxiliary circuits for automatically completing the transfer of the incoming call signal appearing at one section to any one of the other of said sections, and other auxiliary circuits controlled by each of said keysets and each of said switching means for transferring an incoming call signal transferred to a secondary signal lamp to any one other secondary lamps of said plurality at any other of the other of said sections as desired.

3. In a manually operated switching system, according to claim 2, wherein the said lamp paths are provided with means for cross-connecting each of said lamp paths to have either a primary lamp path appearance or a secondary signal lamp path appearance at any one of said switchboard sections as desired.

4. In a manually operated switching system, a switchboard divided into a plurality of primary sections and into a plurality of secondary sections, a plurality of trunks for two-way messages, a switching device, a plurality of circuits accessible to said device and respectively terminating at the primary and secondary answering sections of said switchboard, indicators individual to certain of said circuits respectively appearing at said primary section, indicators individual to the other of said circuits respectively appearing at said secondary section, and means at each of said primary and at each of said secondary sections for transferring a signal appearing on any one of said indicators, primary or secondary, to any one of the secondary sections.

5. In a manually operated switching system, a switchboard divided into a plurality of primary sections and a plurality of secondary sections, a plurality of trunks for two-way messages, a rotary stepping switch individual to each of said trunks, a plurality of auxiliary circuits accessible to each of said switches, primary trunk indicators individual to certain of said auxiliary circuits and respectively appearing at said primary section, a secondary trunk indicators individual to the other of said auxiliary circuits and respectively appearing at said secondary section, means associated with each trunk for selectively actuating the associated trunk indicator at any of said primary or secondary sections, transferring means associated with each section for initiating the transfer of a secondary or primary signal on any of said indicators to any selected section and for causing the functioning of the selecting means aforesaid, a transfer trunk common to all trunks and to all switchboard sections interconnecting said selecting means and said transferring means, and means whereby said transfer trunk is effective for the transfer of only one signal at a time thereby avoiding circuit interference.

6. In a manually operated switching system, a switchboard divided into a plurality of positions, a plurality of trunk circuits for incoming and outgoing messages, a plurality of circuit paths

comprising, a primary signal lamp path and a plurality of secondary lamp paths accessible for connection to each of said trunk circuits and respectively having appearances at different positions, a lamp in each of said paths constituting an appearance, a key set at each of said positions comprising keys for initiating the transfer of incoming call signals on a primary or a secondary signal lamp to any desired secondary signal lamp, and a cross-bar switch common to each group of ten trunk circuits arranged to transfer an incoming call signal transferred to a secondary signal lamp to one of the other secondary signal lamps at any of the other of said positions as desired.

7. In a manually operated switching system, a switchboard divided into a plurality of primary positions and into a plurality of secondary positions, a plurality of trunk circuits for two-way messages, a rotary switch terminating each trunk circuit, a plurality of circuit paths accessible to said switch and terminating in said switchboard

at said primary and said secondary positions, primary trunk signals individual to certain of said circuit paths and respectively appearing at said primary positions, secondary trunk signals individual to certain other of said circuit paths and respectively appearing at said secondary positions, means associated with each trunk for selectively actuating the associated trunk signal at any one of said primary positions, transferring means associated with each position for initiating the transfer of a primary trunk signal to any selected position and for causing the functioning of the selecting means aforesaid, a transfer trunk circuit common to all trunk circuits and to all switchboard positions interconnecting said selecting means and said transferring means, and means whereby said transfer trunk circuit is effective for the transfer of only one signal at a time thereby avoiding interference between trunk circuits.

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