

June 24, 1930.

H. B. JOHNSON

1,767,929

TELEPHONE SYSTEM

Filed Aug. 14, 1929

8 Sheets-Sheet 2

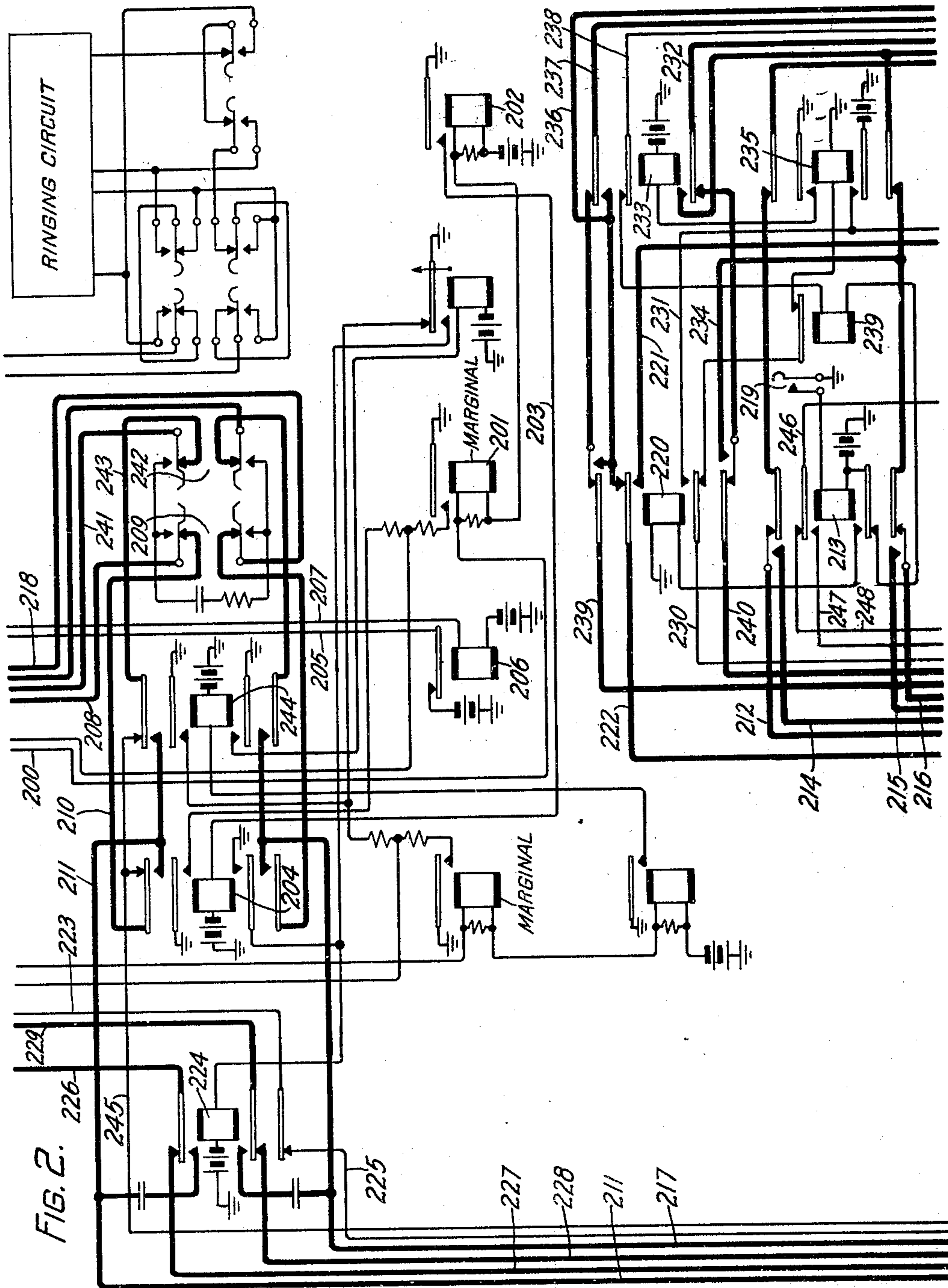


FIG. 2.

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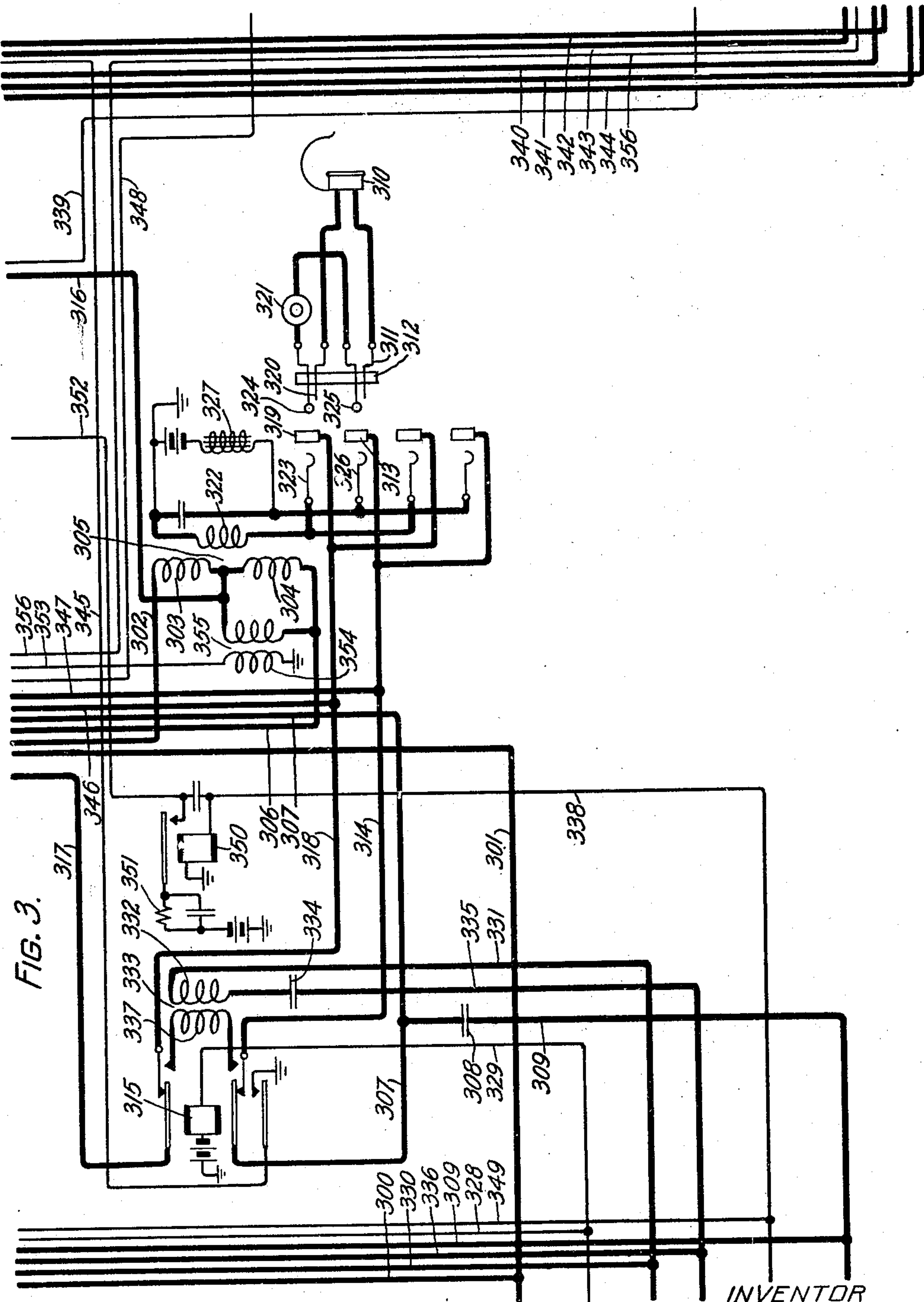
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8 Sheets-Sheet 3



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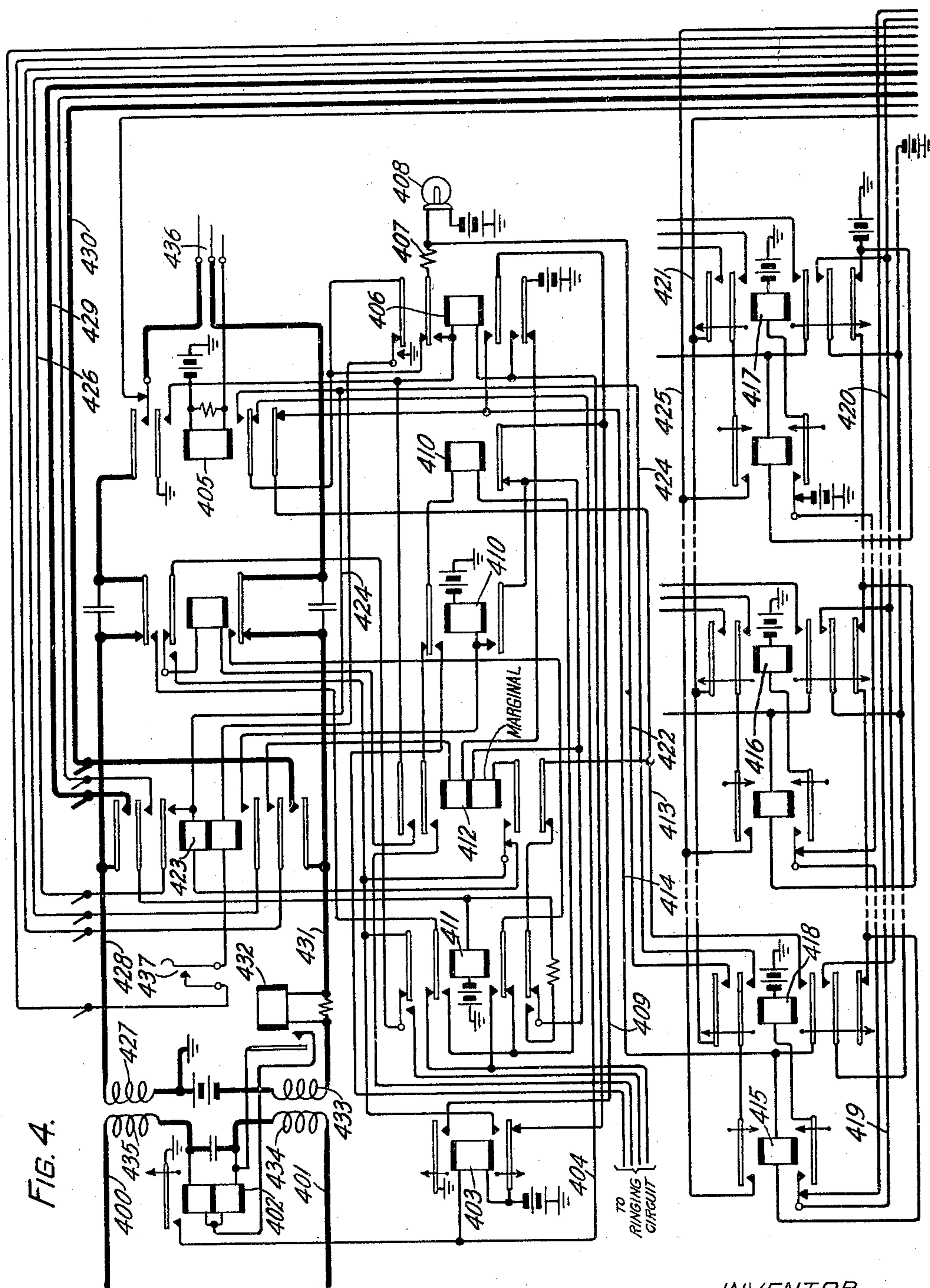
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8 Sheets-Sheet 4



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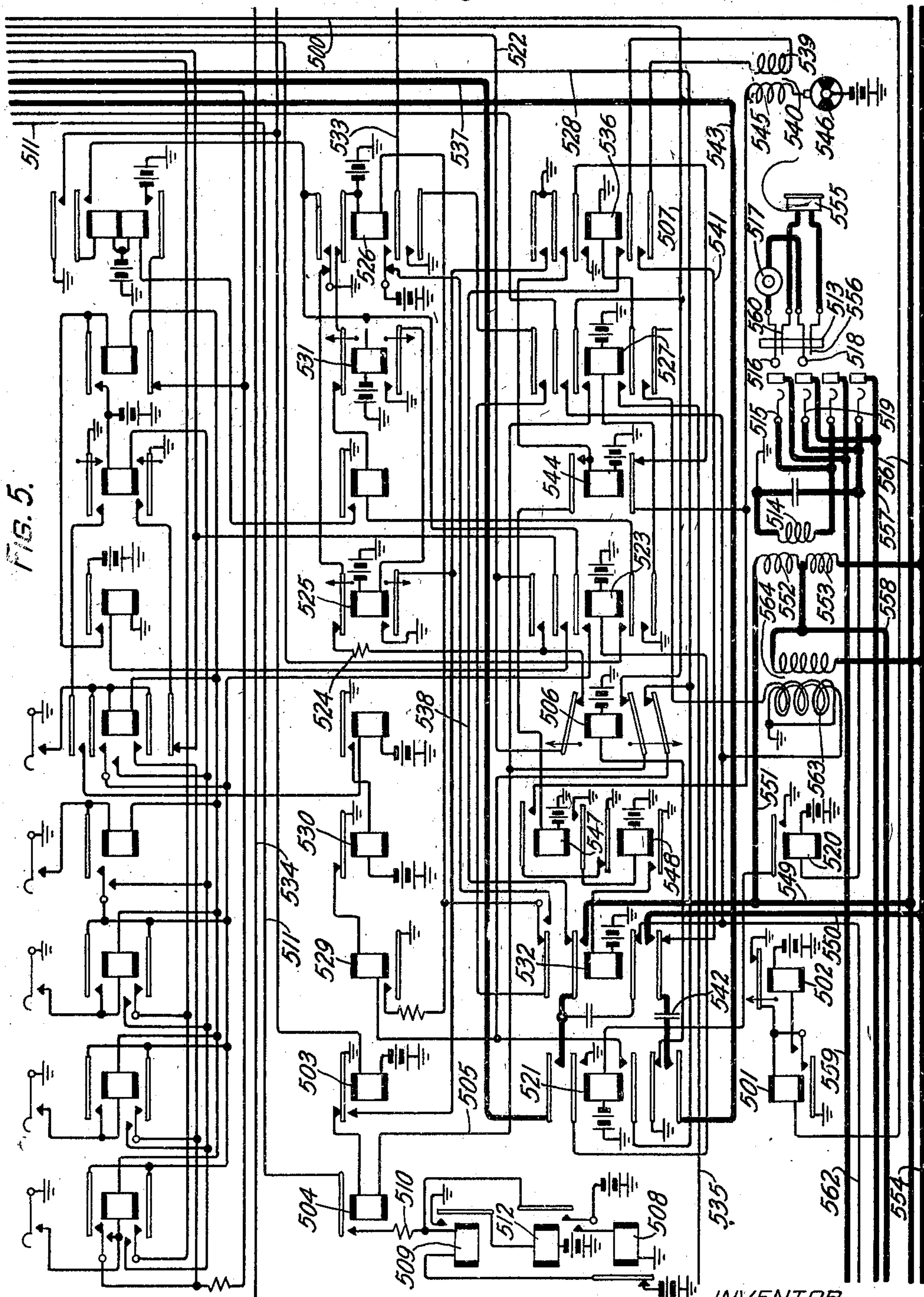
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TELEPHONE SYSTEM

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8 Sheets-Sheet 5



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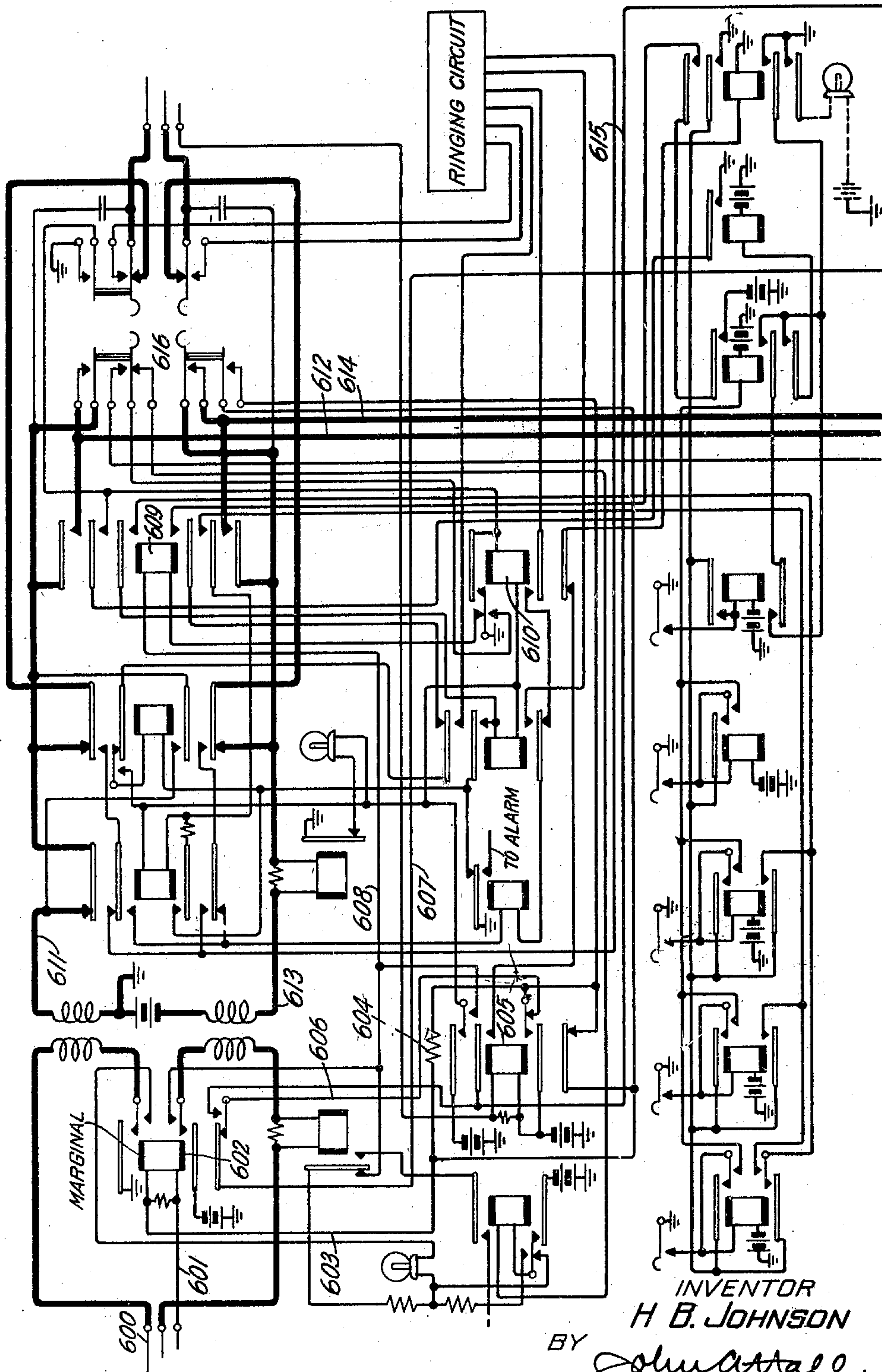
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FIG. 6.



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TELEPHONE SYSTEM

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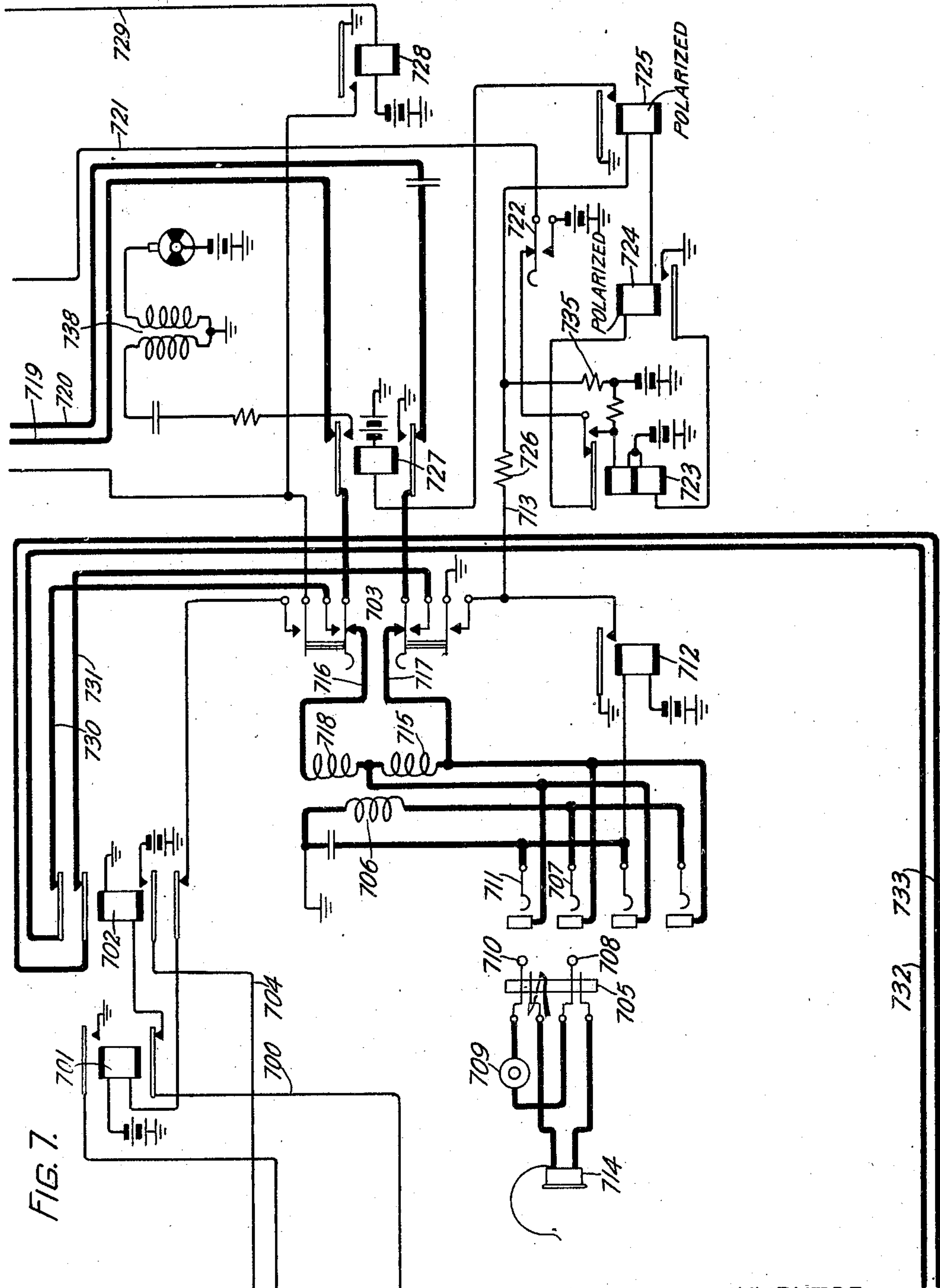


FIG. 7.

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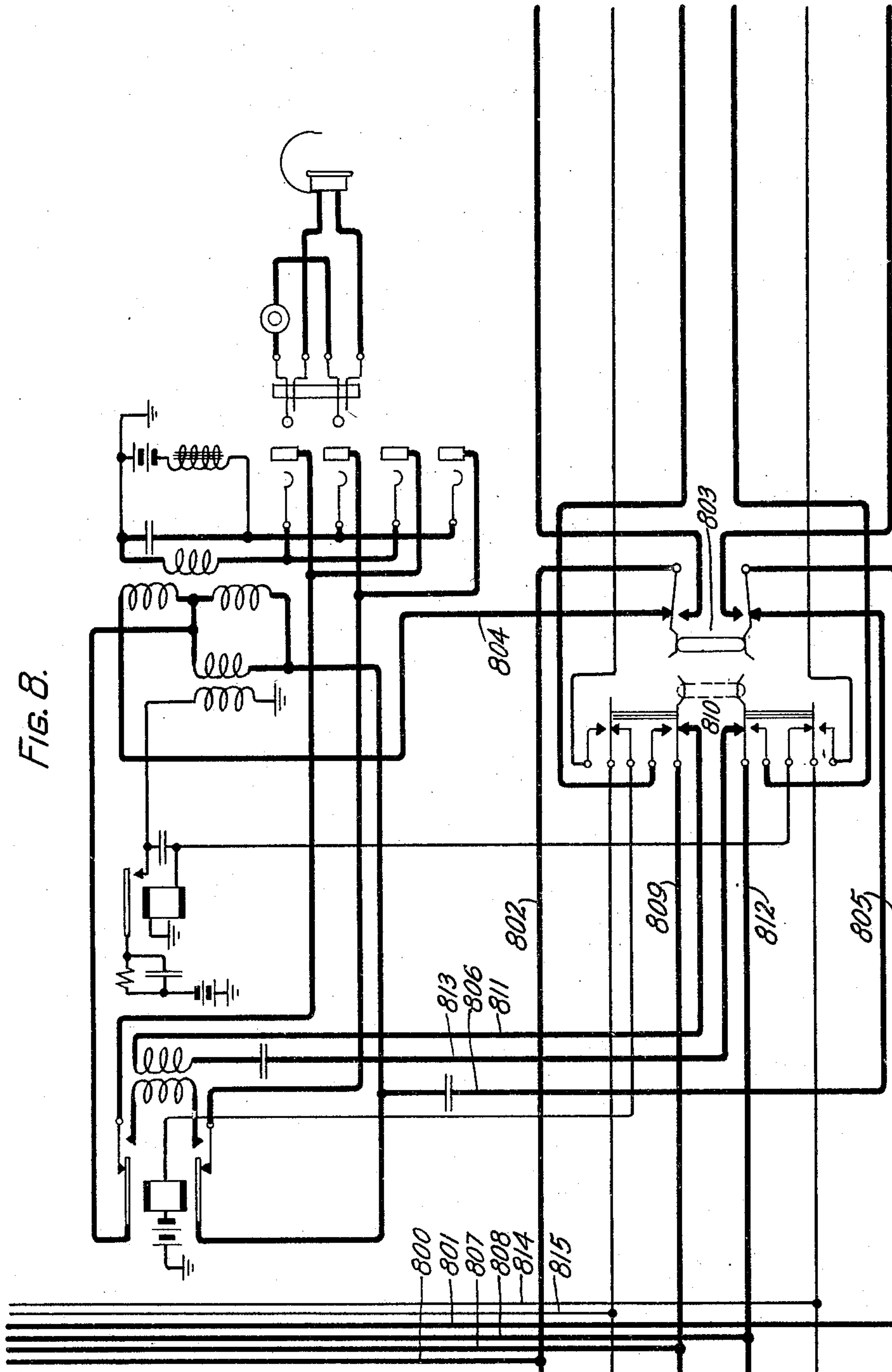
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8 Sheets-Sheet 8



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UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Application filed August 14, 1929. Serial No. 385,881.

This invention relates to telephone systems and particularly to switchboard position circuits and means for grouping positions equipped to handle different kinds of service.

5 Grouping circuits for allowing an operator to use similar circuits at adjacent positions are well known. Broadly also grouping circuits for allowing an operator to handle circuits at an adjacent position which are of a different nature from those at her own position are old. In these prior art systems, however, the operator's telephone set under which several positions have been grouped has not been adapted to perform any functions in addition to those which it normally performs, and this has limited the use of such grouping circuits to systems where the functions of the telephone sets at adjacent positions are similar.

15 The present invention is a means for grouping positions of widely varying character, where the methods of operation at adjacent positions are dissimilar and where the operator's set at one position has to perform functions different from those at an adjacent position. Broadly speaking the present invention resides in means for grouping a plurality of positions under control of one operator's set including means for adapting or rearranging the said one operator's set to perform also the functions normally performed by the other operators' sets at the other positions.

20 The drawings consist of eight sheets of circuit diagrams which when placed as indicated in Fig. 9 illustrate the present invention. Fig. 1 shows a toll cord with the apparatus and circuits individual thereto. Fig. 2 shows the apparatus and circuits common to the toll cords and in the lower right-hand corner the relay and circuit arrangement for coupling an adjacent straightforward operator's position telephone circuit to the toll position is shown. Fig. 3 shows the toll operator's telephone circuit. Fig. 8 shows a similar circuit for an adjacent toll operator's position with a grouping circuit whereby the toll operator of Fig. 3 may handle the toll cords normally under control of the circuits of Fig. 8. Fig. 4 shows an automatic listening

straightforward trunk and its associated sequence circuit. Fig. 5 shows in the upper half the common keys for cooperation with the straightforward trunks of Fig. 4 and in the lower part thereof the operator's control and telephone circuit for cooperation with such straightforward trunks. Fig. 6 shows an A cord circuit and its associated common ringing keys and Fig. 7 shows an operator's telephone set suitable for cooperation with such A cord circuits.

In general the present invention may be explained by the above described drawings in which three types of operators' positions, each normally arranged to perform a different kind of service, are placed adjacent one another and may be grouped under the supervision of a single one. To the left in Figs. 8 and 3 are shown toll operators' telephone sets, in the center in Fig. 5 an automatic listening straightforward operator's telephone set, and to the right, Fig. 7, an A operator's telephone set. Each of these sets will normally cooperate with the particular kind of link circuit at their corresponding positions but all link circuits may be grouped under the control of the automatic listening straightforward trunk operator's set of Fig. 5.

The toll cord of Fig. 1 has a rear plug 100 and a front plug 101, both of which are adapted for cooperation with jacks leading to toll lines. Such line jacks have their sleeves grounded through either a high or a low resistance connection but since differentiating means forms no part of the present invention such jacks and their sleeve connections are neither shown nor will they be further described.

Let it be assumed that the rear plug 100 has been placed in a line jack and the operator wishes to listen in on the cord circuit. She operates listening key 105. A connection will be formed from the ground on the sleeve of the line jack through the sleeve of plug 100, conductor 102, contacts 103 and 104 of the listening key 105, conductor 106, conductor 200, winding of marginal relay 201, winding of relay 202 to battery. Relay 202 will operate in this circuit and relay 201 will also

operate if the plug 100 has been inserted in a jack whose sleeve resistance is low. Upon the operation of relay 202 a circuit is established from ground, armature and contact of relay 202, conductor 203, winding of relay 204 to battery. Relay 204 becomes energized in this circuit.

When key 105 is actuated a circuit is also established from ground to the contacts 107 and 108 of key 105, lower winding of relay 109, conductor 110, conductor 205, back contact and armature of relay 206 to battery. Relay 109 responds in this circuit and locks in a circuit from ground, contacts 107 and 108, upper winding of relay 109, front contact of inner upper armature of relay 109, conductor 111, conductor 207, winding of relay 206, to battery and ground. Relay 206 becomes energized and disconnects battery from conductor 205 so that no other relay such as 109 can become energized as long as key 105 remains in its operated position. A talking circuit may now be traced from the tip of plug 100, tip conductor 112, normal upper contacts of the rear cord ringing key 113, conductor 114, alternate contacts of the outer upper armature of relay 109, conductor 115, conductor 208, normal upper contacts of key 209, conductor 210, outer upper armature and front contact of relay 204, conductor 211, conductor 300, conductor 301, conductor 212, alternate contacts of the outer upper armature of relay 213, conductor 214, conductor 302, windings 303 and 304 of the operator's telephone set repeating coil 305, conductor 306, conductor 215, alternate contacts of the outer lower armature of relay 213, conductor 216, conductor 307, condenser 308, conductor 309, conductor 217, front contact and outer lower armature of relay 204, normal lower contacts of key 209, conductor 218, conductor 116, alternate contacts of the lower armature of relay 109 to ring conductor 117. Thus on the operation of listening key 105, tip conductor 100 and the ring conductor 117 are extended to the windings 303 and 304 of the toll operator's telephone set repeating coil 305. It is assumed that at the present time the key 219 is operated to cause the operation of relays 213 and 220, this being the normal condition when the operator's set of Fig. 3 is associated with the cords such as those of Fig. 1.

It may also be noted at the present time that whenever the listening key 105 is operated and either the rear or front cord is in a line jack that relay 224 is operated. This is for the purpose of allowing the operator to monitor on another cord while she is listening on one.

For listening purposes a connection is extended from receiver 310, through the sleeve 311 of plug 312, sleeve of jack 313, conductor 314, normal contacts of inner lower armature of relay 315, conductor 307, conductor

216, alternate contacts of the outer lower armature of relay 213, conductor 215, conductor 306 to the lower terminal of coil 304 and thence from the upper terminal of coil 304, over conductor 316, conductor 221, front contact and inner upper armature of relay 220, conductor 222, conductor 317, upper armature and back contact of relay 315, conductor 318, sleeve of jack 319, sleeve of plug 320 and thence to the receiver 310.

For talking purposes the transmitter 321 is included in a local circuit from ground, winding 322 of coil 305, tip of jack 323, tip of plug 324, transmitter 321, tip of plug 325, tip of jack 326, impedance coil 327 to battery and ground. The voice currents generated by transmitter 321 will be induced into windings 303 and 304 and transmitted to the tip and ring conductors 100 and 117.

If the toll operator of Fig. 3 wishes to listen in on the toll cord without being heard she will operate key 118 instead of key 105. Upon the operation of key 118 a circuit is established from ground, the lower outer contacts of key 118, conductor 119, conductor 223, outer lower armature and back contact of relay 224, conductor 225, conductor 328, conductor 329, winding of relay 315 to battery.

A listening connection will now be established from tip conductor 100, outer upper contacts of key 118, conductor 120, conductor 226, upper armature and back contact of relay 224, conductor 227, conductor 330, conductor 331, winding 332 of high impedance repeating coil 333, condenser 324, conductor 335, conductor 336, conductor 228, back contact and inner lower armature of relay 224, conductor 229, conductor 121, inner lower contacts of key 118 to ring conductor 117. Through induction voice currents will be transmitted from winding 332 to winding 337 from whence a circuit may be traced through the alternate contacts of the upper armature of relay 315, conductor 318, sleeve of plug 319, sleeve of jack 320, receiver 310, sleeve of plug 311, sleeve of jack 313, conductor 314, alternate contacts of the inner lower armature of relay 315, back to winding 337. In this connection the operator's coil 305 is entirely cut out at the normal contacts of relay 315 so that the operator's transmitter 321 will be entirely ineffective.

In a similar manner cord circuits under the supervision of the operator's set of Fig. 8 may be handled. Conductors 800 and 801 correspond respectively to conductors 300 and 309 so that when a listening key is operated voice currents may be received and transmitted over these conductors in the same manner as explained in connection with Fig. 3. In this case, however, conductor 800 is extended over conductor 802, and thence through the alternate upper contact of key 803 to conductor 804 which corresponds to

conductor 301 and conductor 801 is connected to conductor 805 and thence through the lower alternate contacts of key 803 to conductor 806 which corresponds to conductor 309. In a similar manner conductors 807 and 808 correspond respectively to conductors 330 and 336 and a monitoring connection may be established through the operation of a corresponding monitoring key such as 118. In this instance, however, conductor 807 is connected to conductor 809 and thence through the innermost normal contacts of key 810 to conductor 811 which corresponds to conductor 331 and conductor 808 is connected over conductor 812, the innermost lower contacts of key 810 to conductor 813 which corresponds to conductor 335.

As long as keys 803 and 810 are in the position shown the operator's set of Fig. 8 will be associated with its own corresponding group of toll cords. If, however, it is desired that the toll cords corresponding to the operator's set of Fig. 8 be handled by the operator's set of Fig. 3, or as will be explained hereinafter by the operator's set of Fig. 5, then key 803 is returned to normal and key 810 is operated so that conductor 800 will now be connected through to conductor 301, conductor 807 will be connected through to conductor 331, conductor 808 will be connected through to conductor 335 and conductor 801 will be connected through to conductor 309. In a similar manner the signaling conductors 815 and 814 will be connected through to conductors 329 and 338 respectively so that the operator's set of Fig. 3 will cooperate with the cords corresponding to the operator's set of Fig. 8.

When a call is extended to the straight-forward trunk of Fig. 4 then a battery and grounded connection will be made to conductors 400 and 401 in a manner well known and which will result in current flowing through the two windings in series of relay 402 to cause its energization. Relay 402 becoming energized establishes a circuit from ground, armature and front contact of relay 402, winding of relay 403 to battery and ground. Relay 402 also establishes a circuit from ground, armature and front contact of relay 402, conductor 404, back contact and inner lower armature of relay 405, back contact and inner upper armature of relay 406, resistance 407, signal lamp 408 to battery. Lamp 408 glows steadily in this circuit.

Upon the operation of relay 403 a circuit is established from ground, upper armature and front contact of relay 403, conductor 409, armature and back contact of relay 410, normal contacts of the outer lower armature of relay 411, back contact and outer lower armature of relay 412, conductor 413, lower outer armature and back contact of relay 405, conductor 414, winding of relay 415, and thence through a chain circuit including the

outermost lower armature and back contacts of relays 416 and 417 to battery and ground. If any one of the relays, such as 416, 417 and 418 to the right of the point of access from the winding of relay 415, are energized, then relay 415 cannot become energized at this time. The energization of any one of such relays denotes that the operator is busy on another connection. We will assume that the operator is idle and that, therefore, relay 415 becomes energized.

A circuit will now be established from battery, winding of relay 418, lower armature and front contact of relay 415, conductor 419, conductor 500, winding of relay 501, armature and back contact of relay 502 to ground. Relay 501 becomes energized in this circuit and through its armature and front contacts substitutes a ground for that supplied by the armature of relay 502 and at the same time causes the energization of this latter relay. Thus when a circuit is closed through the windings of one of the relays such as 418 the combination of relays 501 and 502 will be energized without disturbing the ground connection supplied to conductor 500.

For releasing purposes with which we are not concerned at the present time it will be mentioned in passing that upon the opening of the circuit through the winding of relay 501, this relay releases and by so doing removes the ground from conductor 500 and at the same time releases relay 502. Relay 502, however, is slow to release and so maintains conductor 500 open or free from ground for a predetermined interval of time.

Upon the operation of both relays 415 and 418 a circuit is established from ground, armature and back contact of relay 503, winding of relay 504, conductor 505, inner upper armature and front contact of relay 527, conductor 507, conductor 420, front contact and middle lower armature of relay 418 to battery and ground. Relay 504 becomes energized in this circuit and establishes a connection from battery, back contact and armature of relay 508, winding of relay 509, resistance 510, front contact and armature of relay 504 to conductor 511, conductor 421, outer upper armature and front contact of relay 418, conductor 422 to the upper terminal of signal lamp 408, and thence to ground over the circuit heretofore traced from the armature and contact of relay 402. The establishment of this circuit with the winding of relay 509 shunted about signal lamp 408 does not noticeably affect the illumination of the lamp but does result in the energization of relay 509. Relay 509 becoming energized establishes a circuit through the winding of relay 512. Relay 512 in turn attracts its armature and closes a circuit for the energization of relay 508. Relay 508 opens the circuit for relay 509 and relay 512 substitutes a direct battery

connection for shunting signal lamp 408. Thus upon the operation of relay 512 signal lamp 408 will become dark. However, relay 509 is released at this time and this results in the successive release of relays 512 and 508 whereupon the original circuit for signal lamp 408 is reestablished and this lamp again glows. So long as relay 504 is maintained in its energized condition relays 508, 509 and 512 will act and react to cause the periodical flashing of lamp 408. This is a signal to the operator that her set has been or is about to be connected to the particular trunk with which signal lamp 408 is associated.

The manner in which the operator's set is so connected to the trunk of Fig. 4 is as follows: When the operator's plug 513 has been inserted in its corresponding jack a circuit is established from ground, winding of coil 514, tip of jack 515, tip of plug 516, transmitter 517, tip of plug 518, tip of jack 519, winding of relay 520 to battery and ground. Relay 520 is maintained energized as long as plug 513 remains in circuit in its corresponding jack.

The energization of relay 520 results in the establishment of a circuit from ground, front contact and armature of relay 520, winding of relay 521 to battery. Upon the energization of relay 521 the circuit for relay 506 is opened and this relay returns to normal. At the same time a circuit is established from ground, the front contact and inner upper armature of relay 521, winding of relay 523 to battery and ground. Relay 523 becomes energized in this circuit and in turn through its front contact the outer lower armature causes the energization of relay 527.

A circuit may now be traced from battery, lower armature and front contact of relay 403, the normal contacts of the inner lower armature of relay 412, upper winding of relay 423, conductor 424, front contact and inner upper armature of relay 418, upper armature and front contact of relay 415, conductor 425, conductor 522, outer upper armature and front contact of relay 523, resistance 524, back contact and upper armature of relay 525, normal contacts of the outer upper armature of relay 526 to ground.

Relay 423 becoming energized locks in a circuit from battery, lower armature and front contact of relay 403, the normal contacts of the inner lower armature of relay 412, upper winding of relay 423, front contact and innermost upper armature of relay 423, conductor 426, conductor 528, innermost lower armature and front contact of relay 521, winding of relay 529, back contact and armature of relay 530 to ground. Relay 529 becomes energized in this circuit and through its armature and front contact causes the energization of relay 526. Relay 526 attracting its armatures first opens the original

circuit for the energization of relay 423 and through its front contact and upper outer armature places a ground on the winding of relay 531. Relay 531 becomes energized and causes in turn the energization of relay 525.

The energization of relay 526 results in the establishment of a circuit from ground, front contact and outer lower armature of relay 526, outermost upper armature and front contact of relay 527, outermost upper armature and back contact of relay 532, winding of relay 526, this circuit acting as a means for locking relay 526.

Through its front contact and inner lower armature relay 526 places battery on conductor 533 which is extended over conductor 700 through the armature and back contact of relay 701 and thence from winding of relay 702. Relay 702 becomes energized in this circuit and performs two functions. First, if key 703 has been actuated to connect the A cords of Fig. 6 to the operator's set of Fig. 5, then relay 702 opens the talking circuit to such A cords while the operator of Fig. 5 is busy with a straightforward trunk such as that of Fig. 4. Second, relay 702 becoming energized establishes a circuit from battery, front contact and inner lower armature of relay 702, conductor 704, conductor 534, conductor 348, conductor 230, inner lower armature and front contact of relay 220, conductor 231, conductor 339, conductor 535, front contact and inner lower armature of relay 527, winding of relay 536 to ground. Relay 536 becomes energized in this circuit.

A connection may now be traced from ground, winding 427 of the repeating coil of the straightforward trunk of Fig. 4, tip conductor 428, outermost upper armature and front contact of relay 423, conductor 429, conductor 537, outermost upper armature and front contact of relay 521, inner upper armature and back contact of relay 532, conductor 538, front contact and inner lower armature of relay 536, secondary winding 539 of tone coil 540, outer lower armature and front contact of relay 536, conductor 541, back contact and outer lower armature of relay 532, condenser 542, front contact and outer lower armature of relay 521, conductor 543, conductor 430, front contact and outermost lower armature of relay 423, ring conductor 431, supervisory relay 432, winding 433 of the induction coil of the straightforward trunk of Fig. 4 to battery. Through induction any tone which is generated in the secondary winding 539 of the tone coil 540 will be induced in windings 434 and 435 of the induction coil of the straightforward trunk and be then transmitted over conductors 400 and 401 to the outgoing end of such straightforward trunk.

Upon the establishment of this circuit relay 536 closes a circuit from ground, front contact and innermost upper armature of relay

536, back contact and lower armature of relay 544, primary winding 545 of tone coil 540, interrupter 546 to battery. The interrupted current in the primary winding 545 induces a tone in the secondary winding 539 whereby a tone is transmitted over conductors 400 and 401.

Relay 536 now closes a circuit from ground, middle upper armature and front contact of relay 536, winding of relay 544 to battery. Relay 544 becomes energized in this circuit and opens the circuit of the primary coil 545 whereby the transmission of tone over conductors 400 and 401 is stopped. Relay 544 now closes a circuit from ground, middle upper armature and front contact of relay 536, front contact and upper armature of relay 544, winding of relay 547 to battery. Relay 547 becomes energized and establishes a circuit from ground, upper armature and back contact of relay 548, upper armature and front contact of relay 547, winding 545, interrupter 546 to battery. Through this circuit the tone coil 540 is again made effective whereby a second application of tone is placed on conductors 400 and 401. Upon the energization of relay 547 a circuit is established from ground, front contact and lower armature of relay 547, winding of relay 548 to battery. Relay 548 opens the circuit for the primary winding 545 of tone coil 540 and closes a circuit through its lower armature for the energization of relay 532. The tip and ring conductors are now transferred from connection to the winding 539 to connection with conductors 549 and 550 respectively.

A talking connection may now be traced from tip conductor 428, through the outermost upper armature and front contact of relay 423, conductor 429, conductor 537, outer upper armature and front contact of relay 521, inner upper armature and front contact of relay 532, conductor 549, conductor 551, windings 552 and 553 of the operator's set induction coil, conductor 554, conductor 550, front contact and outer lower armature of relay 532, condenser 542, front contact and outermost lower armature of relay 521, conductor 543, conductor 430, outermost lower armature and front contact of relay 423, to ring conductor 431. Transmitter 517 in its local circuit including winding 514 of the operator's set induction coil is, through the agency of this induction coil, coupled to the talking circuit just described. The receiver 555 is coupled to this talking circuit in the following manner: receiver 555, sleeve 556 of plug 513, conductor 557, conductor 340, conductor 232, lower armature and back contact of relay 233, alternate contacts of the outer lower armature of relay 220, conductor 234, back contact and outer lower armature of relay 235, conductor 341, conductor 554, winding 553 of the operator's set induction coil, conductor 558, conductor 342, conductor 236,

alternate contacts of the outer upper armature of relay 220, back contact and outer upper armature of relay 233, conductor 237, conductor 343, conductor 559, sleeve 560 of plug 513, and thence to the receiver 555. It should be noted that with key 219 in its operated position the operator's telephone set of Fig. 5 is so connected that normally both the receiver and transmitter are effective in a talking connection to a straightforward trunk.

Since the further operations in connection with the extension of the straightforward trunk have no connection with the present invention, no further detailed description will be given. In general when the operator of Fig. 5 has communicated with the operator at the outgoing end of the straightforward trunk she will insert the plug 436 into the jack of the desired line and press the release key 437 which will have the effect of disconnecting her telephone set from this trunk and allow the set to be automatically connected to the next following trunk.

The operation of the "A" operator's telephone set will now be described. When the plug 705 is inserted in its jack, a circuit is established from ground, winding 706 of the operator's set induction coil, tip of jack 707, tip of plug 708, transmitter 709, tip of plug 710, tip of jack 711 through the winding of relay 712 to battery and ground. Relay 712 is operated in this circuit and places a ground on conductor 713. The receiver 714 is coupled with the transmitter circuit through the winding 715 of the operator's set induction coil and both are coupled to the talking leads 716 and 717 through the windings 715 and 718. With the key 703 in the position shown, the talking leads 716 and 718 are normally connected to conductors 719 and 720, respectively.

When the answering cord 600 is inserted in a line jack then a connection will be established from a ground found on the sleeve of an idle line over sleeve conductor 601, winding of sleeve relay 602, conductor 603, outer lower armature and back contact of relay 605, normal contacts of the inner lower armature of relay 605, conductor 606, back contact and outer lower armature of relay 602, conductor 607, conductor 721, normal contacts of key 722, normal contacts of relay 723, winding of relay 724, winding of relay 725 and thence to a split circuit going in one direction through resistance 725 to battery and in the other direction to resistance 726 to ground. Both relays 724 and 725 are polarized, but one responds to ground potential and the other responds to battery potential. Assuming that plug 600 has been inserted in the jack of an idle line, then a ground potential will be found and relay 724 will respond. Upon the actuation of relay 724, relay 723 will be energized through its lower winding and will lock over its alternate con-

tacts through its upper winding to the grounded line sleeve. When relay 723 becomes energized, the circuit for relays 724 and 725 is opened and the ground connection through resistance 726 is cut off from conductor 721. Under these circumstances the battery potential on conductor 721 is raised and marginal relay 602 becomes energized.

It is appropriate at this point to note that if plug 600 had been inserted in the jack of a busy line, then a battery potential would have been found and relay 725 would be energized in place of relay 724. When relay 725 becomes operated a circuit is established for the energization of relay 727 which breaks the continuity of the talking circuit between the operator's set and the cord and connects a circuit of tone 728 to the operator's set to warn her that she has plugged in on a busy line.

Upon the operation of relay 602, a circuit is established from battery, inner lower armature and front contacts of relay 602, conductor 608, winding of relay 609, normal contacts of the upper armature of relay 610 to ground. Relay 609 becomes operated in this circuit and through its outermost armatures and front contacts connects the tip conductor 611 to conductor 612 and thence to conductor 719 and the ring conductor 613 to conductor 614 and thence to conductor 720. Thus the operation of relay 609 connects the operator's set of Fig. 7 to the cord circuit.

At the same time a circuit is established from battery, winding of relay 728, conductor 729, conductor 615, alternate contacts of the outer lower armature of relay 602, normal contacts of the inner lower armature of relay 605, back contact and outer armature of relay 605, conductor 603, winding of relay 602 to sleeve, conductor 601 which leads back to a ground connection. Relay 728 is energized in this circuit but without effect at the present time. When the operator's set of Fig. 7 is rendered ineffective by the operation of key 703 and the talking leads 719 and 720 are connected through contacts of relay 702 to leads 732 and 733 and thence to the operator's set of Fig. 5, then the operation of relay 728 will result in the energization of relay 701 to prevent a double connection in case a call on a straightforward trunk should come in while the straightforward operator of Fig. 5 is busy handling an "A" cord such as that shown in Fig. 6.

The cord circuit of Fig. 6 is also provided with an emergency listening key 616 which when operated will directly connect the tip and ring conductors 611 and 613 to conductors 612 and 614 respectively.

Since further operations in connection with the "A" cord have no particular bearing on the present invention, they will not be described.

If it is desired to have the straightforward operator of Fig. 5 handle traffic over the "A" cords of Fig. 6, then the key 703 is operated and the conductors 719 and 720 are connected to conductors 730 and 731 and thence through the back contacts and upper armatures of relay 702 to conductors 732 and 733 which are extensions of conductors 561 and 554 respectively. Conductors 561 and 554 being connected to conductors 549 and 550, respectively, lead to the operator's telephone set of Fig. 5 in its normal condition. Relay 702 is provided so that when the operator of Fig. 5 is busy handling a straightforward trunk, she will not set up a double connection through the insertion of plug 600 into a line jack and relay 701 is provided so that while the operator of Fig. 5 is busy handling an "A" cord she will not set up a double connection through a call coming in over a straightforward trunk.

When it is wished to have the straightforward trunk operator of Fig. 5 handle the traffic over the toll cords of Fig. 1, then key 219 is returned to its normal condition so that relays 213 and 220 become deenergized. Now if the listening key 105 is operated, then a talking circuit may be traced from tip conductor 114, alternate contacts of the outer upper armature of relay 109, conductor 115, conductor 205, normal upper contacts of key 209, conductor 210, outer upper armature and front contact of relay 204, conductor 211, conductor 300, conductor 301, conductor 212, back contact and outer upper armature of relay 213, back contact and outer upper armature of relay 235, conductor 344, conductor 561, conductor 549, conductor 551, windings 552 and 533 of the operator's set induction coil, conductor 554, conductor 341, outer lower armature and back contact of relay 235, outer lower armature and back contact of relay 213, conductor 216, conductor 307, condenser 308, conductor 309, conductor 217, front contact and outer lower armature of relay 204, normal lower contacts of key 209, conductor 218, conductor 116, alternate contacts of the outer lower armature of relay 109 to ring conductor 117. Thus the tip and ring conductors 114 and 117 respectively are effectively connected to the operator's set of Fig. 5 for both talking and listening purposes.

When the operator of Fig. 5 wishes to monitor on one of the toll cords, the monitoring key 118, is operated, whereupon relay 315 is operated a hereinbefore described. The operation of relay 315 establishes a circuit from ground, front contact and outer lower armature of relay 315, conductor 345, conductor 238, inner upper armature and back contact of relay 233, winding of relay 239, back contact and inner lower armature of relay 213 to battery. Relay 239 becomes operated in this circuit to prevent the oper-

ation of relays 233 and 235 during the monitoring period.

A circuit for listening without being heard is now provided for the operator of Fig. 5 as follows: from tip conductor 114, outermost upper contacts of key 118, conductor 120, conductor 226, upper armature and back contact of relay 224, conductor 227, conductor 330, conductor 331, winding 332 of high impedance repeating coil 333, condenser 334, conductor 335, conductor 336, conductor 228, back contact and inner lower armature of relay 224, conductor 229, conductor 121, inner lower contacts of monitoring key 118 to ring conductor 117. Through the operation of relay 315, the winding 337 of the high impedance coil 333 is connected through the alternate contacts of the upper armature of relay 315 over conductor 318, conductor 346, conductor 239, outer upper armature and back contact of relay 220, back contact and outer upper armature of relay 233, conductor 237, conductor 343, conductor 559, sleeve of plug 560, receiver 555, sleeve of plug 556, conductor 557, conductor 340, conductor 232, lower armature and back contact of relay 233, back contact and lower outer armature of relay 220, conductor 240, conductor 347, conductor 314, alternate contacts of the inner lower armature of relay 315 and thence to winding 337 of induction coil 333. Thus the receiver of the operator's set of Fig. 5 is connected for monitoring purposes and the transmitter is ineffective to transmit any voice currents to the conductors 114 and 117 of the toll cord.

When the operator's set of Fig. 5 is connected to cooperate with both the toll cords of Fig. 1 and the straightforward trunks of Fig. 4, if a connection is set up to a straightforward trunk, then as before described, relay 702 will become operated. Upon the operation of this relay the circuit is established from battery, front contact and inner lower armature of relay 702, conductor 704, conductor 534, conductor 348, conductor 230, inner lower armature and back contact of relay 220, armature and back contact of relay 239, winding of relay 235 to ground. Relay 235 becomes energized in this circuit and in turn causes the energization of relay 233. The talking conductors are now cut off between the operator's set of Fig. 5 and the toll cord at the contacts of relay 235 and the continuity of the operator's set of Fig. 5 is maintained by the contacts of relay 233. In other words, whereas before a path was found from conductor 237 over the outer upper armature and back contact of relay 233, the alternate contacts of the outer upper armature of relay 220 to conductor 236 now that relay 220 is in its normal condition and relay 233 is operated, this connection between conductors 237 and 236 is maintained directly over the outer upper armature and front

contact of relay 233. In a similar manner the ring conductor is cut through at the lower armature and front contact of relay 233.

During the period of energization of relays 233 and 235, relay 239 cannot become energized even if a monitoring key 118 is operated.

The circuit heretofore described for the operation of relay 536 effective upon the operation of relay 702 is now established by the inner lower armature and front contact of relay 235 so that the order tone transmitted by the successive operation of relays 536, 544, 547 and 548 is not transmitted until it is sure that the operator of Fig. 5 will not be interfered with by a monitoring operation on the toll cord.

If key 803 is returned to its normal position and key 810 is operated, then the operator of Fig. 5 may handle traffic over toll cords normally associated with the operator's set of Fig. 8 in the same manner as that just described in connection with the operator's set of Fig. 3.

For busy testing purposes, when the tip 122 of the front toll cord is touched to the sleeve of a line jack the battery potential of the busy line jack will be communicated over the tip 122, inner normal contacts of front cord ringing key 123, upper armature and back contact of relay 124, outer upper armature and front contact of relay 109, conductor 125, conductor 241, upper normal contacts of key 242, conductor 243, outer upper armature and back contact of relay 244, conductor 245, conductor 349, conductor 338, winding of relay 350 to ground. Relay 350 responds to this busy potential.

If key 219 is operated at this time a circuit will be established from battery, resistance 351, armature and front contact of relay 350, conductor 352, conductor 246, inner armature and front contact of relay 213, conductor 247, conductor 353, winding 354 of busy test coil 355 to ground. This gives a busy test signal to the toll operator of Fig. 3.

If key 219 is unoperated, then battery on conductor 246 will be extended through the inner upper armature and back contact of relay 213, conductor 248, conductor 356, conductor 562, winding 563 of busy test coil 564 to ground. This gives a busy signal to the straightforward operator of Fig. 5.

What is claimed is:

1. In a telephone system, a first position including an operator's telephone set arranged to function in a first manner, a second position including an operator's telephone set arranged to normally function in a second manner, and means for grouping said positions under control of said second operator's set including means for adapting said second operator's set to function also in the manner of said first operator's set.

2. In a telephone system, a first position

including an operator's telephone set arranged to function in a first manner, a busy test circuit including a relay and a point of access to said first telephone set, a second position including an operator's telephone set arranged to normally function in a second manner, a busy test circuit including only a point of access to said second telephone set, means for grouping said positions under control of said second operator's set including means for adapting said second operator's set to function also in the number of said first operator's set and means for associating said relay with the said point of access to said second telephone set.

3. In a telephone system, a first position including an operator's telephone set arranged to function in a first manner, said set including means for monitoring, a second position including an operator's telephone set arranged to normally function in a second manner, means for grouping said positions under control of said second operator's set including means for adapting said second operator's set to function also in the manner of said first operator's set.

4. In a telephone system, a first position, link circuits of a first nature of said position, an operator's telephone set at said first position adapted to cooperate with said link circuits thereat, a second position, link circuits of a second nature at said second position, an operator's telephone set at said second position normally adapted to cooperate with said link circuits thereat, and means for grouping said positions under control of said second operator's set including means for adapting said second operator's set to cooperate also with the said link circuits at said first position.

5. In a telephone system, a first position, link circuits of a first nature at said position, an operator's telephone set at said first position arranged to cooperate with said link circuits thereat, click reduction means for said link circuits comprising impedance elements and means for temporarily inserting said impedance elements in circuit with said telephone set, a second position, link circuits of a second nature at said second position, an operator's set at said second position arranged to cooperate with said link circuits thereat, and means for grouping said positions under control of said second operator's set including means for adapting said second operator's set to cooperate also with the said link circuits including the said click reduction means at said first position.

6. In a telephone system, a toll position, toll cord circuits at said position, an operator's telephone set at said toll position arranged to cooperate with said cord circuits, a trunk position, automatic listening straight-forward trunks terminating in said trunk position, an operator's set at said trunk position

arranged to cooperate with said trunks, and means for grouping said positions under control of said trunk operator's telephone set including means for adapting said set to cooperate also with said toll cord circuits.

In witness whereof, I hereunto subscribe my name this 9th date of August, 1929.

HERBERT B. JOHNSON.