

April 26, 1966

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3,248,724

PLURAL ORDER DIGIT DISPLAY APPARATUS

Filed Aug. 5, 1960

4 Sheets-Sheet 1

FIG. 1

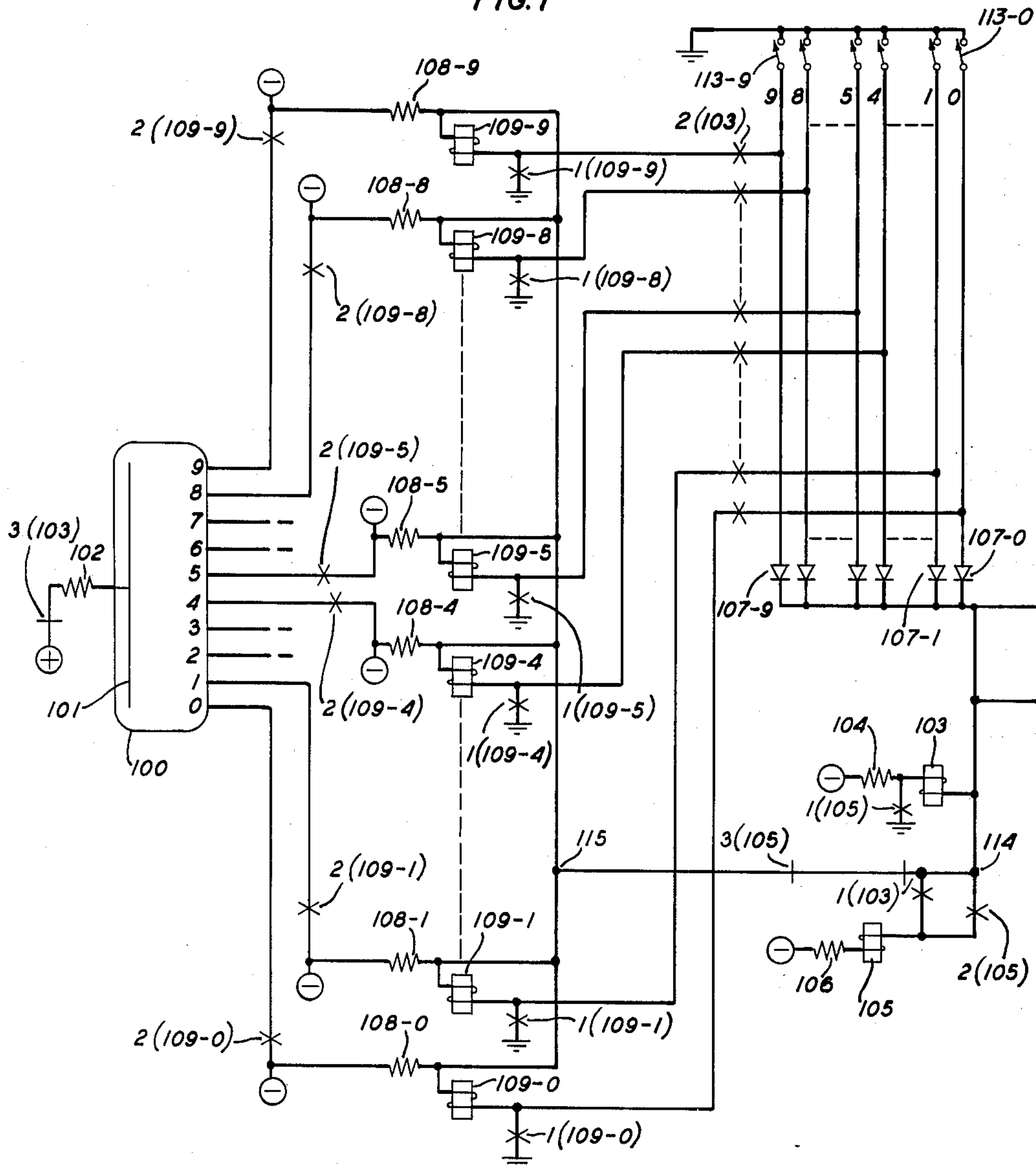
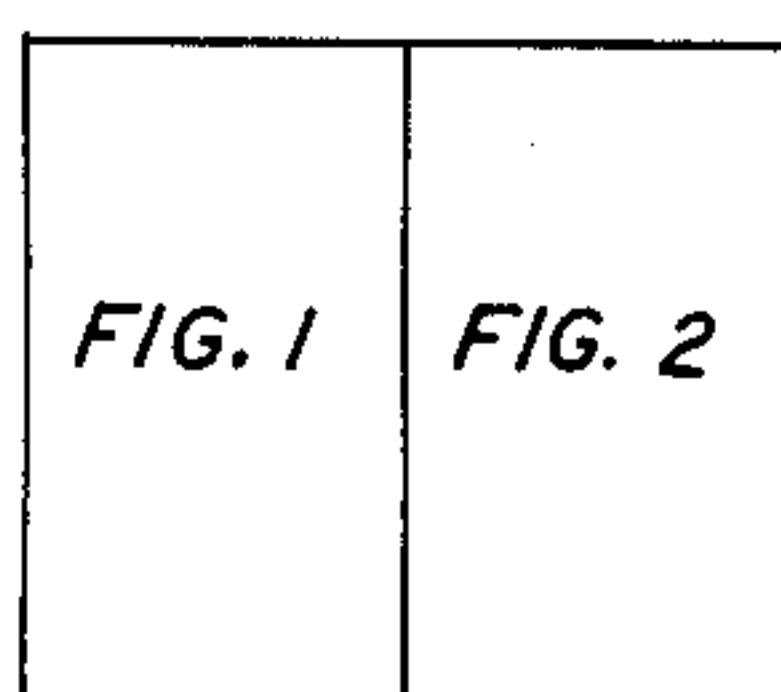


FIG. 5



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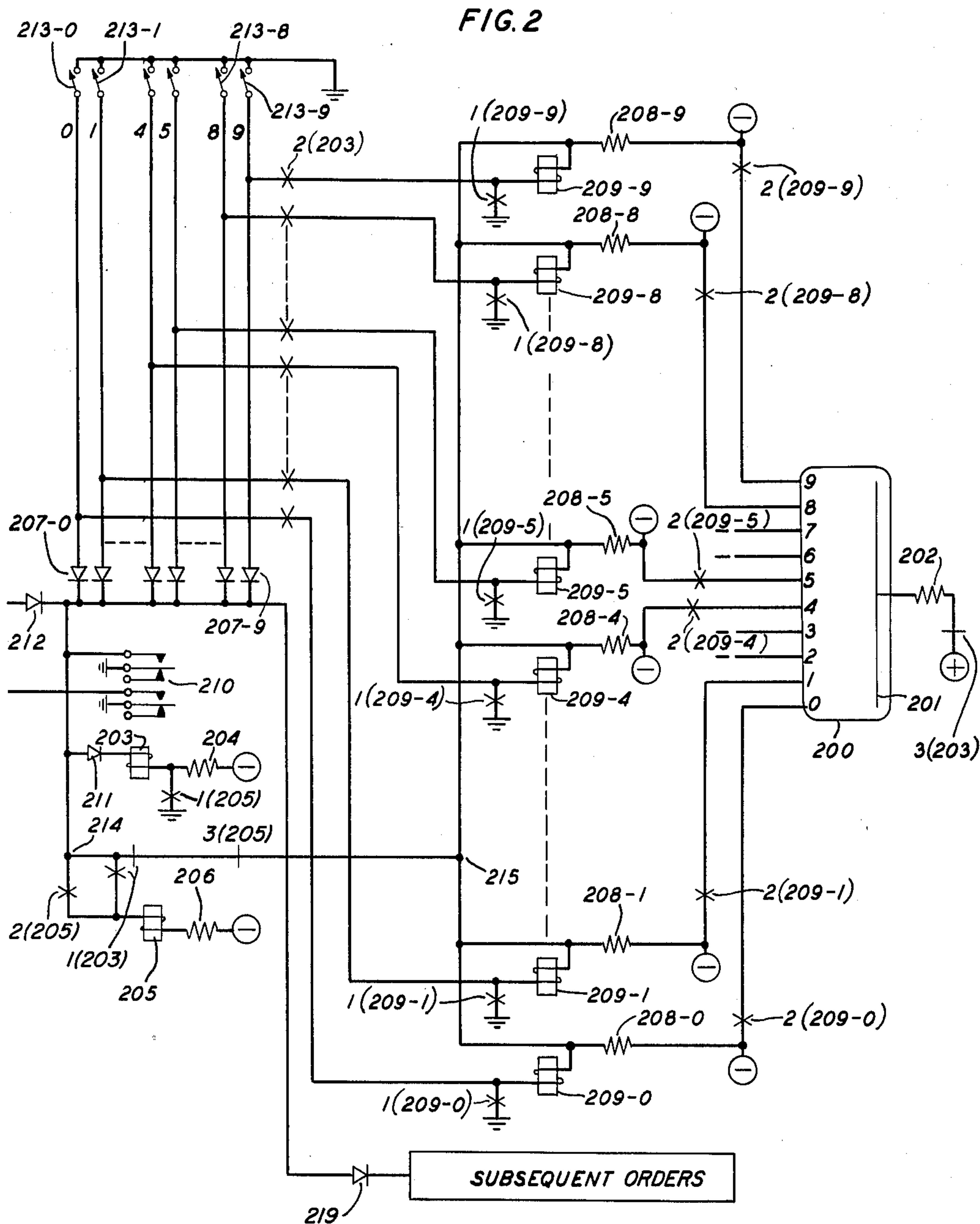
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PLURAL ORDER DIGIT DISPLAY APPARATUS

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4 Sheets-Sheet 2



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PLURAL ORDER DIGIT DISPLAY APPARATUS

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FIG. 6

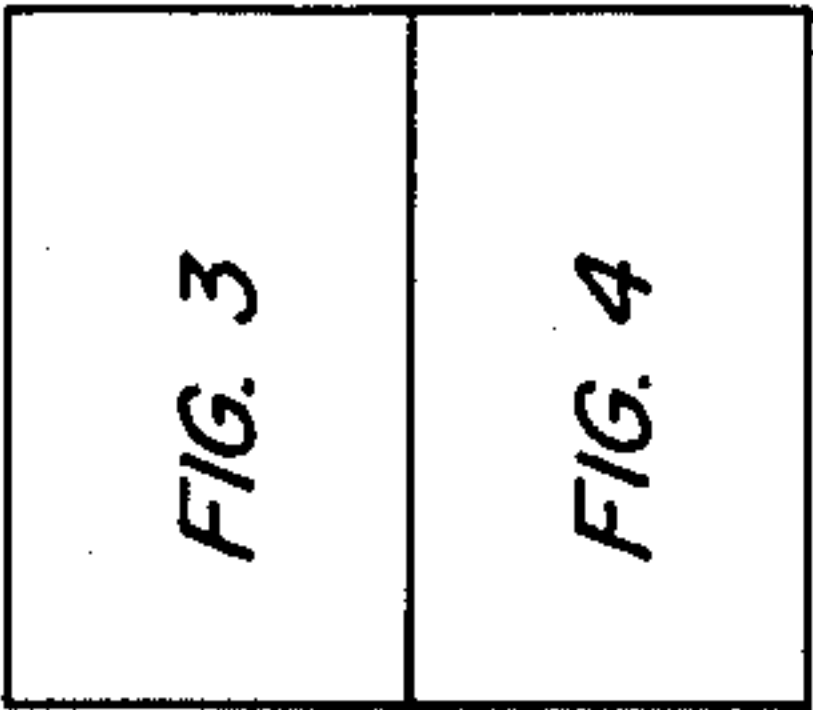
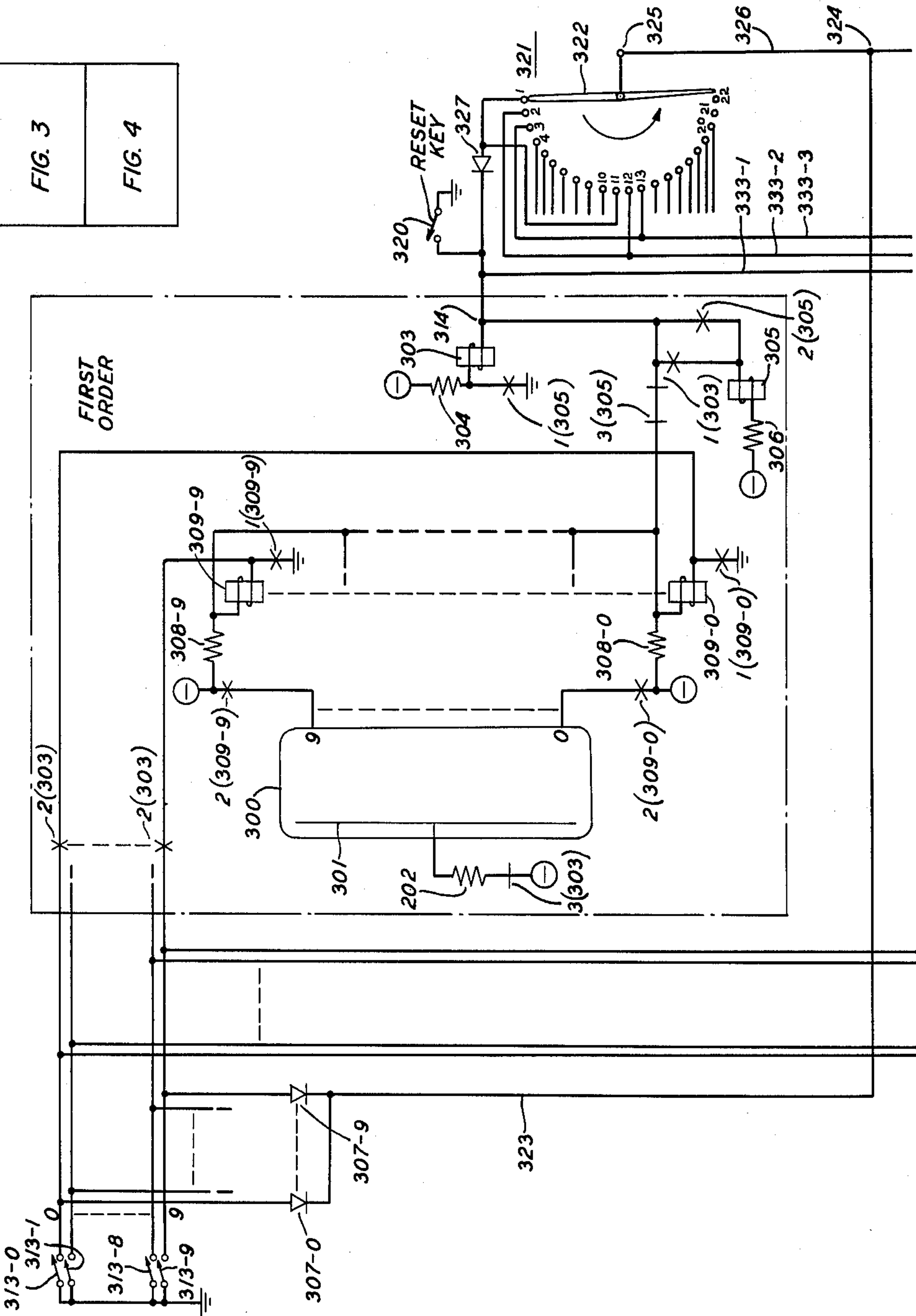


FIG. 3



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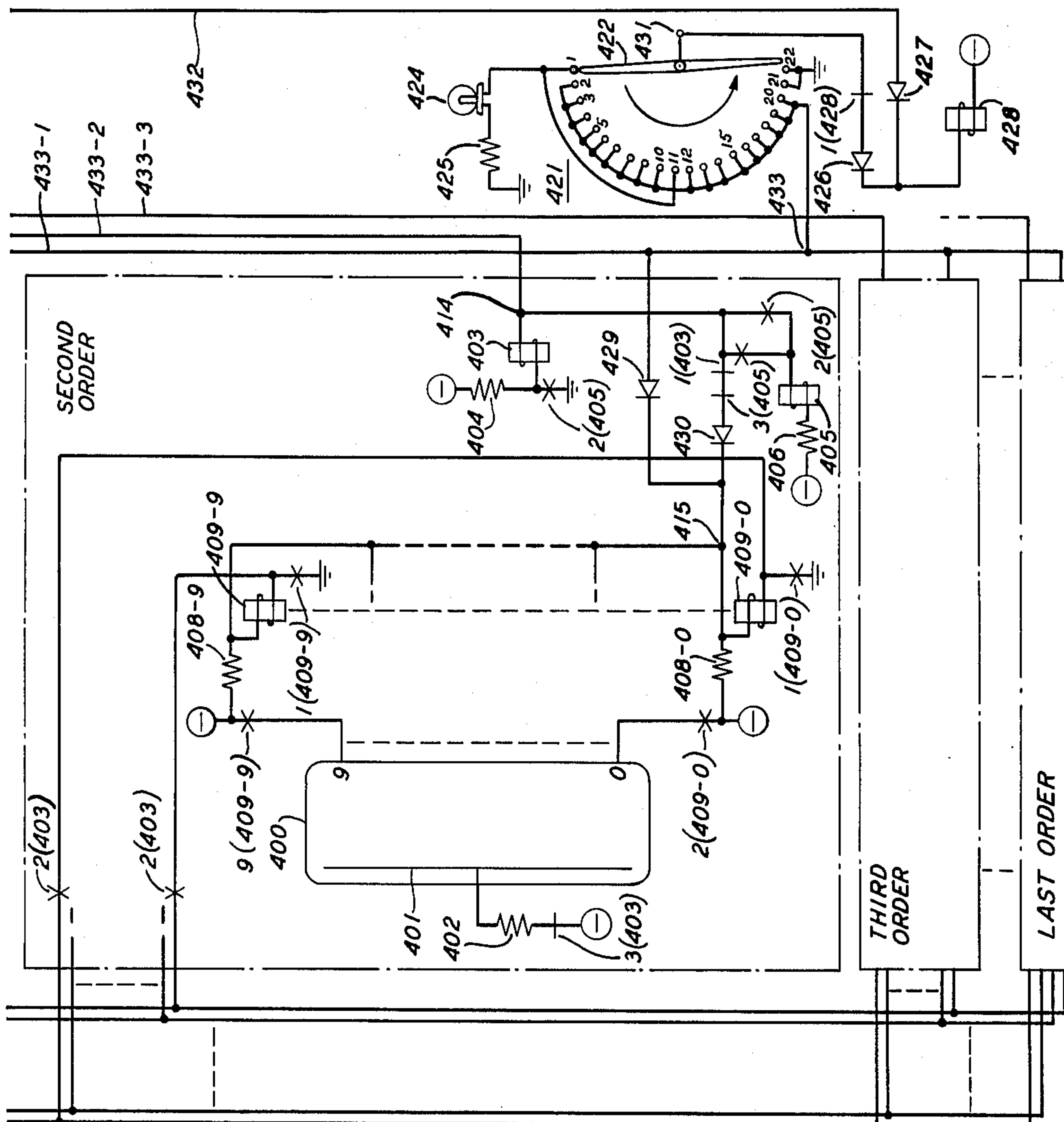


FIG. 4

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3,248,724

PLURAL ORDER DIGIT DISPLAY APPARATUS

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9 Claims. (Cl. 340—324)

This invention relates to an indicator and, more particularly, to a control circuit for an indicator that is selectively operable to display different characters.

Character indicators may be classified into two categories, i.e., nonlocking and locking. A nonlocking indicator maintains a display only during the persistence of the initiating input signal while a locking indicator maintains an existing display after the cessation of the input signal until some positive action is subsequently taken to effect its erasure.

The erase operation in nonlocking indicators presents no problem since each display terminates simultaneously with the cessation of its input signal. However, the termination of displays in locking indicators often leads to complications when high frequency operation is desired since special action must always be taken to erase an existing display before a new one can be effected. Such action is often called a clearing operation in the computer and data processing art.

A clearing action may comprise a special act by the operator if the indicator is manually controlled, or the transmission and reception of a special signal, called a clearing or reset signal, if it is automatically controlled. This clearing operation is a most undesirable requirement since it is time consuming and laborious when the indicator is manually controlled and, due to the cost and complexity of the required equipment, is expensive as well as time consuming when the indicator is automatically controlled.

An object of the invention is to provide an improved visual indicator.

A further object of the invention is to provide a visual indicator having an improved control and reset circuit.

A further object of the invention is to provide a visual indicator of the locking type which requires no special reset operation as it is successively operated to display different characters.

In accordance with the present invention an indicator is provided which comprises an input circuit for receiving information representing a character to be displayed, a control circuit operable upon the receipt of the input information, a register selectively operable by the control and input circuits for registering the character represented by the received information, and an indicator for providing a visual display of the registered character. The aforementioned circuit elements cooperate with one another in such a manner that each display remains locked in until the information for a subsequent display is received whereupon the current display is automatically erased and the subsequent one locked in.

The principles of the present invention are flexible in their utility in that they may be incorporated into plural order indicators of various types depending upon the manner in which the input information is received. If the information is received over a plurality of separate input circuits, each of which is individual to a different order, the indicator may be arranged to receive the information either simultaneously for all orders or sequentially. When the information is simultaneously received, the receipt of information for a new display erases the previous display in each order and locks in the new one as already described. If information is received sequentially character by character, the receipt

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of information representing the first character of a new display simultaneously erases the existing displays in all orders and effects a display of this first character by the first order. This arrangement is highly desirable with sequentially received information since it eliminates the possibility of the indicator providing, at certain times, a meaningless display composed of one or more characters of a new display together with certain unerased characters of the previous display. This undesirable condition would occur with sequentially received data if the current display in all orders is not erased immediately upon the entry into the first order of the first character of a new display.

The principles of the present invention may also be incorporated into a plural order indicator having a single input circuit common to all orders. In this case, the input circuit is advanced from order to order by a distributor as the input data is sequentially received. The indicator operates to effect a display of each received character and also erases all orders of a current display as the first character of a new display is received.

A feature of the invention is the provision of an indicator having a plurality of input conductors whereby the application of a signal to a selected conductor causes the indicator to display a character associated with the energized conductor and whereby the subsequent application of a signal to a different conductor erases the current display and effects a display of the character associated with the subsequently energized conductor.

A further feature of the invention is the provision of an indicator having a plurality of input conductors whereby a signal applied to a first conductor causes the indicator to display the character associated with the first conductor and whereby each subsequently applied signal effects the erasure of the current display and causes a display of the character associated with the energized conductor to which each subsequent signal is applied.

A further feature of the invention is the provision of a plurality of input conductors, a register, a control circuit, and an indicator, whereby the application of a signal to a first conductor operates the control circuit and the register to store a character associated with the first conductor and whereby the storage of this character causes the indicator to display the character until a subsequent signal is applied to a different conductor at which time the control means and the register reoperate to store the character associated with the different conductor and to reoperate the indicator to display the new character.

A further feature of the invention is the provision of a plurality of input conductors, a register, a control circuit and an indicator whereby the application of a signal to a first conductor selectively operates the control circuit and the register to cause the indicator to display a character associated with the first conductor until a subsequent signal is applied to a different conductor at which time the control means and the register reoperate and cause the indicator to display the character associated with the different conductor.

A further feature of the invention is the provision of a plural order indicator which, upon the application of a signal to conductors individual to each order, causes each order to display the character associated with its energized conductor and which when a subsequent signal is applied to a conductor for the first order effects the erasure of the current display in all orders and effects a new display for only the first order of the indicator.

A further feature of the invention is the provision of a plural order indicator which, upon the simultaneous application of signals to conductors individual to each order, causes each order to display the character associated with its energized conductor and which when a subsequent sig-

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nal is applied to a conductor for the first order effects the erasure of the current display in all orders and effects a new display for only the first order of the indicator.

A further feature of the invention is the provision of a plural order indicator having a plurality of leads associated with each order together with means for simultaneously applying a signal to one conductor in each order whereby the indicator displays the characters associated with the energized conductors and whereby the subsequent application of a signal to only a conductor in the first order effects the erasure of the current display in all orders and causes a new display by the first order of the character associated with its subsequently energized conductor.

A further feature of the invention is the provision of a plural order indicator having a plurality of leads associated with each order together with means for simultaneously applying a signal to one conductor in each order whereby the indicator displays the characters associated with the energized conductors and whereby the subsequent application of a signal to only a conductor in one of the intermediate orders effects the erasure of the current display in said intermediate as well as in all subsequent orders and the initiation of a new display by the intermediate order of the character associated with the subsequently energized conductor.

A further feature of the invention is the provision of a plural order indicator having a plurality of leads associated with each order together with means for sequentially applying a signal to one conductor in each order whereby the indicator displays the characters associated with the energized conductors and whereby the subsequent application of a signal to only a conductor in the first order effects the erasure of the current display in all orders and the initiation of a display by the first order of the character associated with the energized conductor.

A further feature of the invention is the provision of a plural order indicator having a plurality of leads associated with each order together with means for sequentially applying a signal to one conductor in each order whereby the indicator displays the characters associated with the energized conductors and whereby the subsequent application of a signal to only a conductor in an intermediate order effects the erasure of the current display in the intermediate as well as in all subsequent orders and the initiation of a display by the intermediate order of the character associated with the energized conductor.

A further feature of the invention is a provision of a plural order indicator having a set of conductors common to all order whereby the application of a first signal to any one of the conductors causes the first order to display a character associated with the energized conductor and whereby the application of successive signals to others of the conductors causes the successive orders to display the character represented by each energized conductor.

A further feature of the invention is a provision of a plural order indicator having a set of conductors common to all orders whereby the application of a first signal to any one of the conductors causes the first order to display a character associated with the energized conductor and whereby the application of successive signals to others of the conductors causes the successive orders to display the character represented by each energized conductor with each display remaining until a new display is entered into the first order whereby the display in each other order is erased.

A further feature of the invention is a provision of a plural order indicator having a distributor and a set of conductors common to all orders whereby, upon the application of successive signals to various ones of the conductors, the distributor is operative to cause the successive orders to display the character represented by each energized conductor.

These and other objects and features of the invention

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may be more readily understood when taken in connection with the following description and drawings in which:

FIGS. 1 and 2 together disclose a plural order indicator having a separate set of input conductors for each order;

FIGS. 3 and 4 together disclose a plural order indicator having a single set of input conductors common to all orders; and

FIGS. 5 and 6, respectively, show how FIGS. 1 and 2 and FIGS. 3 and 4, respectively, should be arranged with respect to each other.

Detailed description—FIGS. 1 and 2

FIGS. 1 and 2 together disclose the first two orders of a plural order indicator having a separate set of input conductors for each order. The first order is shown on FIG. 1 and, basically, comprises a set of input conductors designated 0-9, a control circuit comprising relays 103 and 105, a register circuit comprising the ten relays 109-0 through 109-9, and an indicator tube 100. The second order of the indicator is shown on FIG. 2 and, except for the minor differences hereinafter discussed, is similar to the circuit of FIG. 1. The orders of the indicator subsequent to the second are diagrammatically represented by the rectangle in the lower right-hand corner of FIG. 2. Each such subsequent order contains apparatus and circuit elements similar to that of the first and second orders as shown in detail on FIGS. 1 and 2, respectively. Corresponding parts for the first two orders on FIGS. 1 and 2 are designated with corresponding numbers for ease of comparison.

Referring to FIG. 1, each input conductor 0-9 is functionally associated with a digit 0-9 and the momentary application of a ground potential to any conductor is effective to operate the control circuit and the register whereby the indicator tube displays the digit associated with the grounded conductor. For example, the momentary closure of contacts 113-9 applies a ground potential to conductor 9 which effects the operation of the aforementioned circuit elements so that indicator tube 100 provides a display of the digit 9. Contacts 113-0 through 113-9 may comprise a portion of various equipments depending upon the manner in which the present invention is used. Thus each contact 113- may be associated with a different manually operable key if the indicator is to be manually controlled. On the other hand, each contact 113- may comprise the contact of a different control relay or solenoid if the indicator is to be controlled automatically such as by a register, a data transmitter, etc.

Indicator tube 100 has an anode and a plurality of cathodes. The tube may be operated to sustain a conduction between its anode and any one of its cathodes. Each cathode represents one of the digits 0-9 and each is so shaped that the initiation of a conduction between it and the anode effects a display of the digit represented by the energized cathode. A further description of the operation of this tube need not be made herein since such tubes are well known in the art and are commercially available. For example, the Burroughs Corporation of Plainfield, New Jersey, makes a complete series of indicator tubes having the aforementioned characteristics.

The operation of the circuit of FIG. 1 may best be understood if it is first assumed that the indicator is already operated and displaying a particular digit. Thus, let it be assumed that indicator tube 100 is currently displaying the digit 9. In this case, relay 109-9 is held operated by the ground supplied to one side of its winding through its closed make contacts 1(109-9) and by the battery supplied to the other side of its winding through resistor 108-9. This relay, when operated, maintains a path from negative battery, through its closed make contacts 2(109-9), to the cathode in the ninth position of the indicator tube 100 which at this time has a positive

potential on its plate. The application of these potentials causes the tube to display the digit 9.

Next, let it be assumed that it is desired to erase the 9 and to display a 5. In this case, contacts 113-5 are momentarily closed to apply a ground pulse to conductor 5. The ground on this conductor is transmitted through diode 107-5 to terminal 114, through break contacts 1(103) and 3(105), to terminal 115. The ground on terminal 115 is extended to the junction of each resistor 108 and the upper winding terminal of its associated relay 109. Relays 109-0 through 109-8 are unoperated at this time and therefore unaffected by this ground on their upper winding terminals. However, the appearance of this ground on the right hand terminal of resistor 108-9 grounds the negative potential holding relay 109-9 operated and causes it to release. The release of this relay opens its make contacts 2(109-9) to remove the battery potential from cathode 9 of tube 100 and thereby terminates the display of the digit 9. Make contacts 1(109-9) also open at this time and break the holding path for relay 109-9 so that it does not reoperate upon the termination of the ground pulse on terminal 115.

The ground through diode 107-5 is simultaneously applied to the right hand side of the winding of relay 103 at the same time that it is applied to terminal 114. The appearance of this ground on the winding of relay 103 ultimately causes the relay to operate since the other side of its winding is connected to battery through resistor 104. However, resistor 104 delays the operation of relay 103 sufficiently so that relay 109-9 is able to release and effect the erasure of the digit 9 on the indicator tube before relay 103 operates.

The operation of relay 103 opens its contacts 3(103) to erase the display in tube 100 and also opens its break contacts 1(103) which remove the short circuit ground on the upper winding terminal of relays 109-0 through 109-9. The operation of relay 103 also closes its ten make contacts 2(103) whereby the ground pulse on conductor 5 is transmitted through its associated contacts 2(103) to the winding of relay 109-5. This relay now operates since the other side of its winding is connected to battery through resistor 108-5. The operation of relay 109-5 closes its make contacts 1(109-5) to complete a holding path to ground which holds the relay operated upon the termination of the ground pulse on conductor 5. The operation of this relay also closes its make contacts 2(109-5) to complete a path from negative battery to the cathode 5 of the indicator tube to cause it to display the digit 5 after relay 103 releases and recloses its contacts 3(103). The operation of relay 103 also closes a path from ground on terminal 114, through its make contacts 1(103), to operate relay 105. Relay 105 in operating closes a locking path for itself through its make contacts 2(105) to ground on terminal 114. Relay 105 in operating also effects the release of relay 103 by applying a ground through its make contacts 1(105) to the right hand terminal of resistor 104. This ground short circuits the resistance battery on the left hand winding terminal of relay 103 and causes it to release.

The operation of relay 105 also opens its break contacts 3(105) so that the ground on terminal 114 will not be applied to terminal 115 and relays 109 by the break contacts 1(103) as they close upon the release of relay 103.

The circuit remains in this condition with relay 105 and relay 109-5 operated for the duration of the momentary ground on input conductor 5. When this ground is finally removed by the opening of contacts 113-5, ground through diode 107-5 is removed from terminal 114 which, in turn opens the holding path for relay 105 and causes it to release.

At this time, the indicator tube 100 is energized over its fifth cathode and displays the digit 5. Also, relay 109-5 is held operated over its make contacts 1(109-5) to ground. The entire circuit of FIG. 1 remains in this

condition and no further circuit actions occur until another ground pulse is subsequently applied to one of input conductors 0-9 on FIG. 1. When the next pulse is applied, it reoperates the control circuit, releases the register circuit to erase the display of the digit 5, and reoperates the register to cause the indicator tube to display the digit associated with the energized input conductor, all in a manner similar to that described in connection with the erasure of the digit 9 and the display of the digit 5.

The second order of the indicator is shown on FIG. 2 and is similar in most respects to the circuit of FIG. 1. For example, the second order comprises a set of input conductors designated 0-9, a control circuit comprising relays 203 and 205, a register comprising the ten relays 209-0 through 209-9, and an indicator tube 200. The circuit of FIG. 2 operates in a manner identical to that in FIG. 1 whereby a ground pulse on any input conductor effects a display by indicator tube 200 of the digit associated with the energized input conductor. Also, the next and each subsequent input ground pulse effects the erasure of any current display and a display of the digit associated with the input conductor to which it is applied.

Key 210 on FIG. 2 permits a current display to be erased in both orders without the initiation of a new display. The operation of this key closes its lower contacts which apply a ground to terminal 114. The ground on this terminal is extended over break contacts 1(103), 3(105), terminal 115, to the upper winding terminal on each of relays 109-0 through 109-9. This ground short circuits the battery on the resistor 108 associated with the one operated relay 109 to effect its release as already described. The release of this relay de-energizes indicator tube 100 and terminates its display. The ground on terminal 114 also operates relay 103 which, in turn, operates relay 105 which, in operating, releases relay 103 as described. Relay 105 remains operated over its make contacts 2(105) to ground on terminal 114 as long as key 210 is operated.

No register relay 109 is operated upon the closure of key 210 in conjunction with the subsequent operation of relay 103 since the diodes 107 are poled to prevent the passage therethrough of the ground on key 210.

The operation of key 210 also closes its upper contacts which apply a ground to terminal 214 to erase any current display on indicator tube 200 and to restore the entire circuit to normal in a manner identical to that of FIG. 1. The release of key 210 removes the ground from terminals 114 and 214 to release relays 105 and 205 and leave the circuits of FIGS. 1 and 2 in an unoperated condition.

Diode 212 effectively interconnects terminals 114 and 214 and is provided in order that a display in the second and subsequent orders of the indicator may be erased upon the application of a ground to any input conductor in the first order. For example, if all orders of the indicator are currently operated to display a particular combination of digits, the application of a ground pulse to any input conductor of FIG. 1 erases the current display for the first order and effects the display of the digit associated with the energized conductor. The ground on this input conductor is also applied through its associated diode 107, through diode 212 to terminal 214. The ground on terminal 214 simulates a reset ground from key 210 and, in a similar manner, erases the current display for this order without initiating a new display therein. The ground on the output of the diode 212 is also applied through diode 219 to the corresponding portion of the next subsequent order, as indicated, to erase the current display therein. Also, in order to facilitate the erasure operation in the subsequent orders, each subsequent order is connected to the next following order by means of a diode similar to diode 219.

The circuit feature provided by diodes 212 and 219 is useful in situations where the displays are initiated

sequentially order by order rather than simultaneously. For example, a ten order indicator of the type shown on FIGS. 1 and 2 could be used to increase the dialing proficiency of toll telephone operators by providing visible displays of the telephone numbers dialed during their training program. When so used, the first order shown in FIG. 1 displays the first digit dialed, the second displays the second digit dialed, and so on up to the last which displays the last digit dialed. Once the operator trainee has dialed a complete number and has ascertained from the indicator that the proper digits were dialed, she then proceeds to dial the first digit for the next telephone number. Once the first digit of a new number is dialed, it is most desirable that the indicator should only display the first digit of the new number rather than the first digit of the new number together with the remaining digits of the preceding number.

This feature is provided by diodes 212 and 219. If diodes 212 and 219 were not provided, and, if it should be desired that portions of a new display should never be shown with the remnants of a previous display, it would then be necessary for key 210 to be operated to erase a current display before the digits for a new display could be received. Diodes 212 and 219 are poled so that a subsequent ground on the input conductors of FIG. 2, for example, cannot be transmitted backwards through diode 212 to effect an unwanted circuit operation in FIG. 1.

The preceding description of FIGS. 1 and 2 has assumed that the input information is sequentially received order by order and thus, tubes 100, 200, etc., are likewise energized sequentially. As discussed, this sequential receipt of input information requires the use of the diodes 212, 219, etc., so that all digits of a current display will be erased whenever the first order receives information pertaining to a new display.

The indicator shown on FIGS. 1 and 2 is not limited to arrangements wherein the input information is sequentially received and, if desired, it could also receive information simultaneously. In this case, diodes 212 and 219 would not be required since the conditions necessitating their use are unique to the sequential mode of operation.

Detailed description—FIGS. 3 and 4

FIGS. 3 and 4 together disclose a plural order indicator having a single set of input conductors, designated 0-9, common to all orders. The data representing the characters to be displayed is sequentially applied to the input conductors by the momentary closure of selected ones of contacts 313-0 through 313-9. A distributor, which advances one step subsequent to the reception of each character, directs each received character to its associated order of the indicator.

The circuit elements exclusive to the first order are shown inside the dashed rectangle on FIG. 3. Similarly, the circuit elements exclusive to the second order are shown inside the large dashed rectangle on FIG. 4 while the equipment exclusive to the third and subsequent orders is shown only in diagrammatic form. The distributor is shown on the right hand part of FIGS. 3 and 4 and comprises a rotary stepping switch of the type commonly used in telephone switching systems.

The equipment exclusive to each order and shown within the dashed rectangles is similar to the previously described circuits of FIGS. 1 and 2. For example, the equipment exclusive to the first order on FIG. 3 includes a control circuit comprising relays 303 and 305, a register circuit comprising the ten relays 309-0 through 309-9 and an indicator tube 300. With but a few minor exceptions hereinafter discussed, the equipment exclusive to the second order is shown on FIG. 4 and is identical to that on FIG. 3.

Let it be assumed that the digits 909 are sequentially transmitted to the indicator of FIGS. 3 and 4 by the sequential and momentary closure of contacts 313-9, 313-0, and 313-9 in that order. The first closure of con-

tacts 313-9 applies a ground pulse over input conductor 9, through diode 307-9, over conductor 323, terminal 324, conductor 326, terminal 325, wiper 322 of switch 321 which is currently in its normal position as illustrated, the contact in position 1 of the switch, through diode 327, to terminal 314. The ground on this terminal operates relay 303 in a manner similar to that described for relay 103 on FIG. 1. The operation of relay 303 operates relay 305 and closes contacts 2(303). The closure of contacts 2(303) extends the ground on input conductor 9 to the winding of relay 309-9 which operates and completes a locking path for itself so that it remains operated after relays 303 and 305 release when contacts 313-9 are opened. The operation of relay 309-9 closes an energizing path for the ninth cathode of the tube to initiate a display of the digit 9 when relay 303 releases. Relay 303 releases subsequent to the operation of relay 305. The ground on terminal 324 is also applied over conductor 432, through diode 427 to the magnet 428 of the stepping switch. The operation of magnet 428 performs no function at this time since rotary switches of this type advance their wipers upon the release rather than the energization of their stepping magnets.

The release of contacts 313-9 removes ground from conductor 324 which releases relay 305 in a manner similar to that of relay 105 on FIG. 1. Relay 309-9 remains operated over its locking path and maintains the tube 300 energized over its ninth cathode to display the digit 9. The release of contacts 313-9 also removes the ground on conductor 432 to release magnet 428 and advance its wipers 322 and 422 one step counterclockwise as shown.

In summary so far, the reception of the first digit 9 causes the first order of the indicator to display a 9 and advances the rotary switch one position counterclockwise so that its wipers 322 and 422 now engage the contacts in its second position. Next, contacts 313-0 are momentarily operated to transmit the digit 0 to the indicator. The closure of these contacts applies a ground pulse over conductor 0, through diode 307-0, over conductor 323, terminal 324, conductor 326, terminal 325, and wiper 322 which is currently engaging the contact in its second position. The ground on wiper 322 is extended over conductors 333-2 and 433-2 to terminal 414 in the second order. The ground on this terminal momentarily operates relay 403 in a manner similar to that previously described whereby it closes its contacts 2-403 for a period of time sufficient to permit the ground on input conductor 0 to be transmitted over its associated contacts 2(403) to operate relay 409-0. Relay 409-0 in operating completes a locking path for itself and, when relay 403 releases, energizes the cathode in the 0 position of the indicator tube 400 to display the digit 0. The ground on terminal 414 also operates relay 405 which in operating releases relay 403. The equipment in the second order remains in this condition with its relays 405 and 409-0 operated as long as the ground remains on input conductor 0.

The ground on terminal 324 at this time is also applied over conductor 432, through diode 427 to operate magnet 428 to prepare it for a subsequent stepping of the switch.

The subsequent opening of contacts 313-0 removes the previously described ground holding relay 405 operated and causes it to release. The release of this relay leaves relay 409-0 operated and leaves the tube 400 energized to display the digit 0. The release of contacts 313-0 also breaks the holding path for magnet 428 to release it and advance its wipers one step counterclockwise so that it now engages the contacts in its third position.

The subsequent momentary closure of contacts 313-9 causes the equipment comprising the third order of the indicator to operate and initiate a display of the digit 9. The momentary operation of these contacts also causes the magnet 428 to advance its wipers one position so that they now engage the contacts in their fourth position.

The receipt of each subsequent digit by the input con-

ductors operates succeeding orders of the indicators in a similar manner whereby they effect a display of each digit.

Each bank of the selector has 22 contact positions even though the present circuit requires only 20 contacts. A 22 position selector switch is used since such a switch is commercially available while a 20 position switch is not.

The selector bank associated with wiper 322 connects the control circuits of the successive orders with the pulse grounds on conductor 323 as the characters are sequentially received. This bank is wired with the control circuit for the first order connected to the contacts in positions 1 and 11, the control circuit for the second order connected to the contacts in positions 2 and 12, and each succeeding order similarly connected to contacts in two different positions. Thus, for a ten order indicator the control circuit for the tenth order is connected to the contacts in positions 10 and 20. The contacts in positions 21 and 22 on FIG. 326 are not used for a ten order indicator.

The contacts associated with wiper 422 comprise part of a reset circuit to restore the switch to its position 1 or 11. For example, let it be assumed that the selector is in its fifth position when it is desired, for some reason, to cancel the existing display and prepare the circuit for the reception of a new display. In this case, reset key 320 is closed to apply a ground over conductors 333-1 and 433-1 to terminal 433. The ground on this terminal is applied to the contacts in positions 2 through 10 and 12 through 20 of the switch. Since the switch is assumed to be in its position 5, the ground on this contact is applied over its wiper 422, terminal 431, break contacts 1(428) of magnet 428, diode 426 to energize magnet 428. This magnet operates and, in so doing, immediately breaks its operating path at its contacts 1(428) whereby it releases and advances its wipers one position. A similar stepping action occurs as wiper 422 engages each contact in positions 6 through 10 which are also currently grounded by the closure of the reset key 320. Magnet 428 continues this stepping action each time its wiper 422 engages a grounded contact. The stepping action ceases once the wiper 422 engages the contact in position 11 since both this contact as well as the contact in position 1 are not grounded by the operation of the reset key.

Positions 1 and 11, 2 and 12, 3 and 13, etc. are strapped as shown on FIG. 3 and, thus, immediately upon the termination of a reset operation, the selector is ready for the reception of the digits for a new display and, in response thereto, directs the first received digit to the first order, the second to the second order, and so on, in a manner similar to that already described. The last received digit, the tenth digit, is directed to the tenth order at the time the selector engages the contact in its twentieth position. Immediately after the reception of the twentieth digit, magnet 428 is released and advances its wipers to their twenty-first position. The contacts in positions 21 and 22 on FIG. 4 are grounded and so the magnet receives two stepping pulses to advance the switch two positions whereby the other end of its wiper 422 engages the contacts in position 1. The circuit is now prepared to receive the input pulses for the next display.

Whenever the selector is in its first or its eleventh position, a path is closed from ground, resistor 425, lamp 424, the contacts in positions 1 or 11, wiper 422, terminal 431, break contacts 1(428), diode 426, through the winding of magnet 428 to battery. The current through this path energizes lamp 424 which serves as a ready light to advise the attendant that the circuit is in condition to receive information for the next display. However, the current is limited by resistor 425 so that magnet 428 does not operate over this path.

The reception of the first digit for the next display erases the current display in the first order and initiates a display of the new digit. Also, the ground on the conductor representing this digit is applied through one of

diodes 307-0 through 307-9, through the selector on FIG. 3, over conductors 333-1 and 433-1 to a diode in each succeeding order, such as diode 429 in the second order, to short circuit any operated register relay therein and erase its current display. Thus, each diode, such as diode 429, performs the same function as diodes 212 and 219 whereby the current display in all other orders is immediately erased upon the initiation of a new display by the first order.

Diode 426 prevents the operating ground for magnet 428, as supplied by conductor 432, from being applied through the selector switch to conductor 433-1 which, when grounded, erases any display in all orders. For example, if the selector were in its second position and if diode 426 were not in the circuit, an operating ground on magnet 428 would also be applied through wiper 422, the contact in the second position, terminal 433, conductor 433-1 to the diode 429 in the second order and to the corresponding diodes in the subsequent orders. As has already been explained, a ground on the input of these diodes erases the current display in all orders of the indicator.

The purpose of diode 427 is to prevent misoperation of the control circuit of the first order indicator due to ground applied through resistance 425, lamp 424, wiper 422, terminal 431, contacts 1 (428), diodes 426 and 427, conductors 432 and 326, and wiper 322 when the selector is in position 1 or 11.

The purpose of diode 429 is to prevent digit pulse grounds, other than that for the first order, from effecting the erasure of displays in any of the other orders of the indicator. For example, if diode 429 in the second order were not provided, an operating ground on conductor 433-2 for the second order would appear on conductor 433-1. As has already been explained, a ground on conductor 433-1 erases the current display in all orders of the indicator.

The purpose of diode 430 in the second order as well as the corresponding diode in each subsequent order is to prevent the operation of relays 403 and 405 in the second order, and the operation of the corresponding relays in the subsequent orders, whenever a ground is applied to conductor 433-1 to effect an erasure of the displays in the second and all subsequent orders.

The purpose of diode 327 is to prevent the selector from advancing to position 2 or 12 upon release of the manual reset key. For example, if diode 327 were not in the circuit and a manual reset were effected, when the selector reached position 1 or 11, ground would still be applied to the selector magnet 428 from key 320 through wiper 322, conductors 326 and 432, and diode 427. As previously explained, removal of this ground will cause the selector to advance to the next position.

It is to be understood that the above-described arrangements are but illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. In a visual indicator having first and subsequent orders each of which is operable for sequentially displaying information characters; a group of input conductors for each order with each conductor within a group being individual to one of said characters, switch means for applying an input signal to a selected conductor in each group, registration means individual to each of said conductors, a control circuit individual to each order and operable in response to an input signal on any conductor for its order to operate the registration means individual to said any conductor, means responsive to the operation of said registration means for causing the indicator for its order to display the character associated with said any conductor, means

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for maintaining said display until a subsequent signal is received by a conductor for said first order, said switch means being subsequently effective for applying a signal to a selected conductor for said first order, and means responsive to the application of said subsequently applied signal for erasing the current display in all of said orders and for effecting the display by said first order of the character associated with the conductor to which said last named signal is applied.

2. In a visual indicator having a first, a second and at least one subsequent order with each order being operable for sequentially displaying information characters; a group of input conductors for each order with each conductor within a group being individual to one of said characters, switch means for applying an input signal to a selected conductor in each group, registration means individual to each of said conductors, a control circuit individual to each order and operable in response to an input signal on any conductor for its order to operate the registration means individual to said any conductor, means responsive to the operation of said registration means for causing the indicator for its order to display the character associated with said any conductor, means for maintaining said display until a subsequent signal is received by a conductor for said second order, said switch means being subsequently effective for applying a signal to a selected conductor for said second order, and means responsive to the application of said subsequently applied signal for erasing the current display in said second and in each subsequent order while maintaining the current display by said first order and for effecting the display by said second order of the character associated with the conductor to which said last named signal is applied.

3. In a visual indicator having a first and subsequent orders each of which is operable for sequentially displaying information characters; a group of input conductors for each order with each conductor within a group being individual to one of said characters, switch means for applying an input signal to a selected conductor in each group, registration means individual to each of said conductor, a control circuit individual to each order and operable in response to an input signal on any conductor for its order, contacts operable upon the operation of the control circuit for an order to operate the registration means individual to said any conductor in its order, contacts operable upon the operation of said registration means for causing the indicator for its order to display the character associated with said any conductor, means for maintaining said display until a subsequent signal is received by a conductor for said first order, said switch means being subsequently effective for applying a signal to a selected one of the conductors for said first order, and means responsive to the application of said subsequently applied signal for erasing the current display in all of said orders and for effecting the display by said first order of the character associated with the conductor to which said last named signal is applied.

4. In an N order visual indicator for sequentially displaying information characters, a plurality of input conductors common to all of said orders with each conductor being individually associated with one of the characters that may be displayed by each order, switch means for applying an input signal to a selected one of said conductors, means solely responsive to the application of said signal to said selected conductor for causing a first order of said indicator to display the character associated therewith, said switch means being effective for selectively applying N-1 additional signals one at a time to said conductors, means solely responsive to the application of said additional signals for causing successive orders of said indicator to sequentially display the character represented by each conductor to which said additional signals are applied, means for maintaining said display in all orders

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until an Nth+1 signal is received by one of said conductors, said switch means being effective for applying an Nth+1 signal to one of said conductors, and means solely responsive to the application of said Nth+1 signal for erasing the current display in all of said orders and for effecting the display by said first order of the character associated with the conductor to which said Nth+1 signal is applied.

5. In an N order indicator for sequentially displaying information characters, a plurality of input conductors common to all of said orders with each conductor being individually associated with one of the characters that may be displayed by each order, a distributor responsive to the receipt of successive signals by said conductors for connecting said input conductors to sequential orders of said indicator, switch means for selectively applying a first input signal to one of said conductors, means including said distributor solely responsive to the application of said first signal for causing the first order of said indicator to display the character associated with the conductor to which said first signal is applied, means responsive to the termination of said first signal for causing said distributor to connect said plurality of input conductors to the second order of said indicator, said switch means being effective for sequentially and selectively applying additional signals to said conductors, means including said distributor responsive to the reception of N-1 additional signals for causing said successive orders to display the character represented by each conductor to which said N-1 additional signals are applied, means for maintaining said display in all order until an Nth+1 signal is applied to one of said conductors, and means solely responsive to the application of an Nth+1 signal for erasing the current display on all of said orders and for effecting the display by said first order of the character associated with the conductor to which said Nth+1 signal is applied.

6. In an indicator for displaying information characters, a plurality of input conductors each of which is individual to one of the characters that may be displayed, switch means for applying an input signal to any selected one of said conductors, registration means individual to each of said conductors, control circuit means operable solely in response to an input signal on any of said conductors for immediately operating the registration means individual to said selected one conductor, means responsive to the operation of said registration means for energizing said indicator to display the character individual to said selected one conductor, means for maintaining said display by said indicator until a signal is next applied to one of said conductors, said switch means being subsequently operative for applying an input signal to any selected one of said conductors, and means including said control circuit means responsive solely to the application of said subsequently applied signal for erasing the current display on said indicator and for effecting a display of the character individual to said last named conductor.

7. In an indicator for displaying information characters, a plurality of input conductors each of which is individual to one of said characters that may be displayed, switch means for applying an input signal to any selected one of said conductors, registration means individual to each of said conductors, control circuit means connected in common to all of said conductors and operable solely in response to an input signal on any one thereof, contacts operable upon the operation of said control circuit means for interconnecting each registration means with its input conductor, means immediately effective upon said interconnection for operating the registration means individual to said selected one conductor, contacts operable upon the operation of said registration means for energizing said indicator to display the character individual to said selected one conductor, locking means for maintaining the operation of said registration means and said display by said indicator until a signal is next applied to one of said conductors, said switch means being subsequently

effective for applying an input signal to any selected one of said conductors, and means including said control circuit means responsive solely to the application of said subsequently applied signal for releasing the currently operated registration means and thereby erasing the current display on said indicator, said control circuit means and said registration means being responsive to the application of said subsequently applied signal for effecting a display of the character individual to said last named conductor.

8. An N order indicator comprising; a plurality of input conductors common to all orders with each conductor being individual to a character that may be displayed by said indicator in each of its orders, registration means in each order individual to each of said conductors, control circuit means in each order connectable in common to all of said conductors and operable solely in response to an input signal on any one thereof, means immediately effective upon the operation of the control circuit means for an order for operating the registration means in the same order individual to the conductor currently receiving an input signal, means in each order operable upon the operation of the registration means in the same order for energizing said indicator to display the character individual to the conductor currently receiving an input signal, switch means effective for successively applying N signals one at a time to selected ones of said conductors, means responsive to the application of said N signals for connecting the control circuit means in each of said orders sequentially to said input conductors thereby effecting a sequential display of the N characters represented by the conductors to which said N signals are applied, means for maintaining said display in all orders until an Nth+1 signal is received by said conductors, said switch means being subsequently effective for applying an Nth+1 signal to one of said conductors, and means solely responsive to the application of said Nth+1 signal for erasing the current display in all of said orders and for effecting a display by said first order of the character individual to the conductor to which said Nth+1 signal is applied.

9. An N order visual indicator comprising; a plurality of input conductors common to all orders with each conductor being individual to a character that may be displayed by said indicator in each of its orders, registration

means in each order individual to each of said conductors, control circuit means in each order connectable in common to all of said conductors and operable solely in response to an input signal on any one thereof, contacts in each order operable upon the operation of its control circuit means for interconnecting each registration means in the same order with its individual input conductor, means immediately effective upon said interconnection for operating the registration means individual to the conductor currently receiving an input signal, contacts in each order operable upon the operation of one of the registration means in the same order for energizing said indicator to display the character individual to the conductor currently receiving an input signal, switch means effective for successively applying N signals one at a time to selected ones of said conductors, distributor means responsive to the application of said signals for connecting the control circuit means in each of said orders sequentially to said input conductors thereby effecting a sequential display of the N characters represented by the conductors to which said N signals are applied, means for maintaining said display until an Nth+1 signal is received by said conductors, said switch means being subsequently effective for applying an Nth+1 signal to one of said conductors, and means solely responsive to the application of said Nth+1 signal for erasing the current display in all of said orders and for effecting the display by said first order of the character individual to the conductor to which said Nth+1 signal is applied.

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