April 7, 1964 J. A. SNELL 3,128,455

INDICATION SYSTEM AND STORAGE APPARATUS

Filed Nov. 24, 1961 3 Sheets-Sheet 1

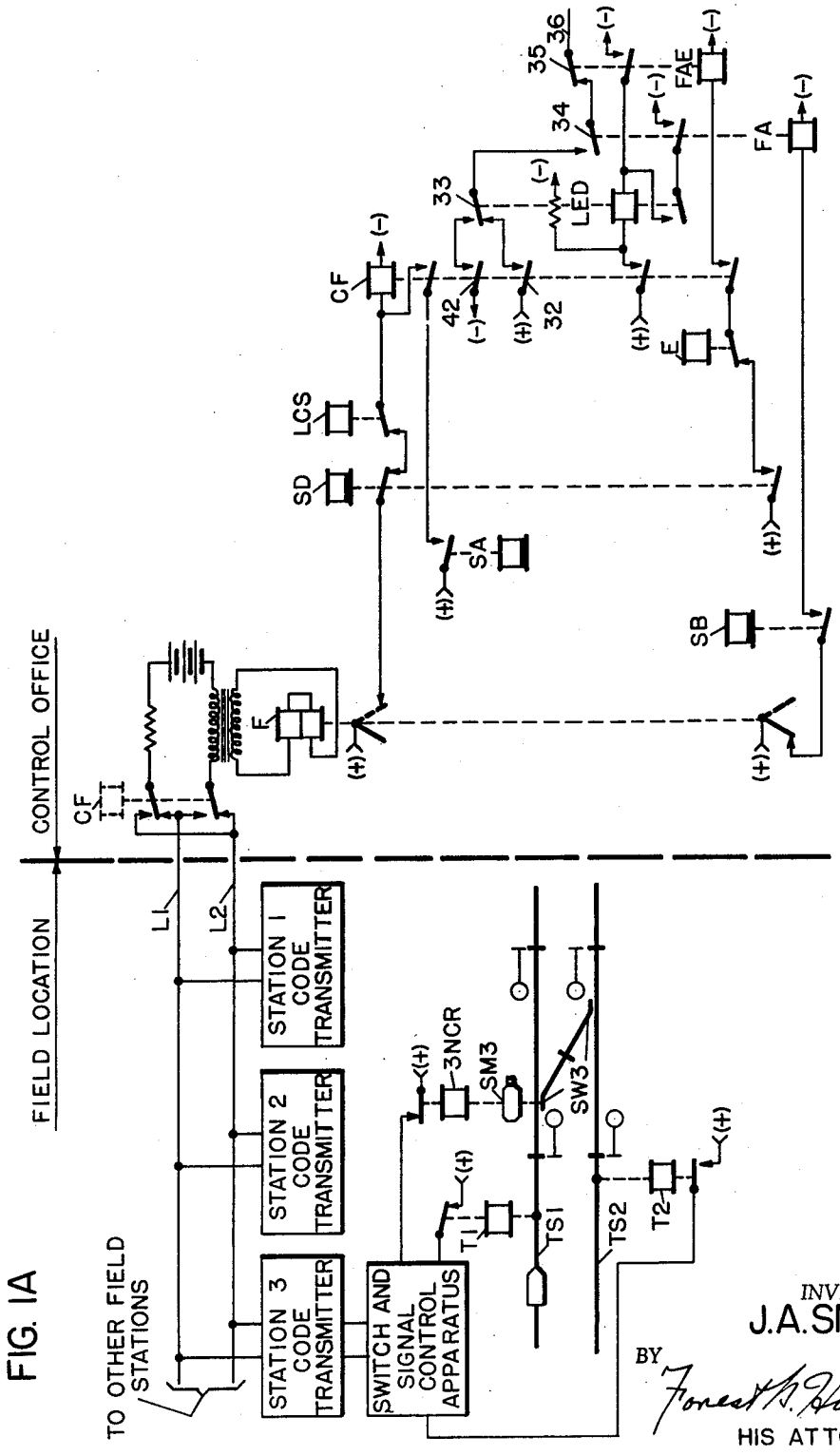


FIG. 1A

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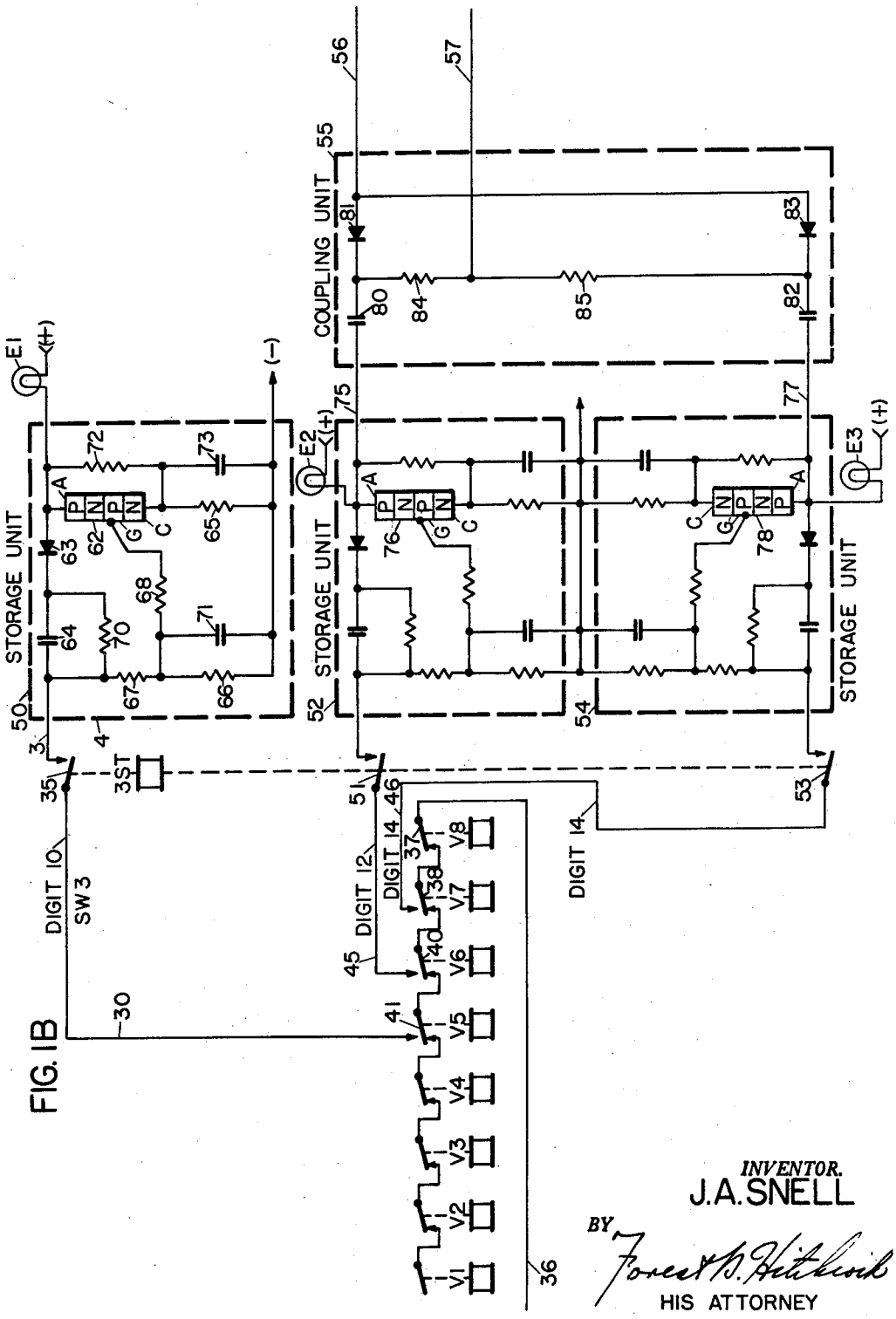


FIG. 1B

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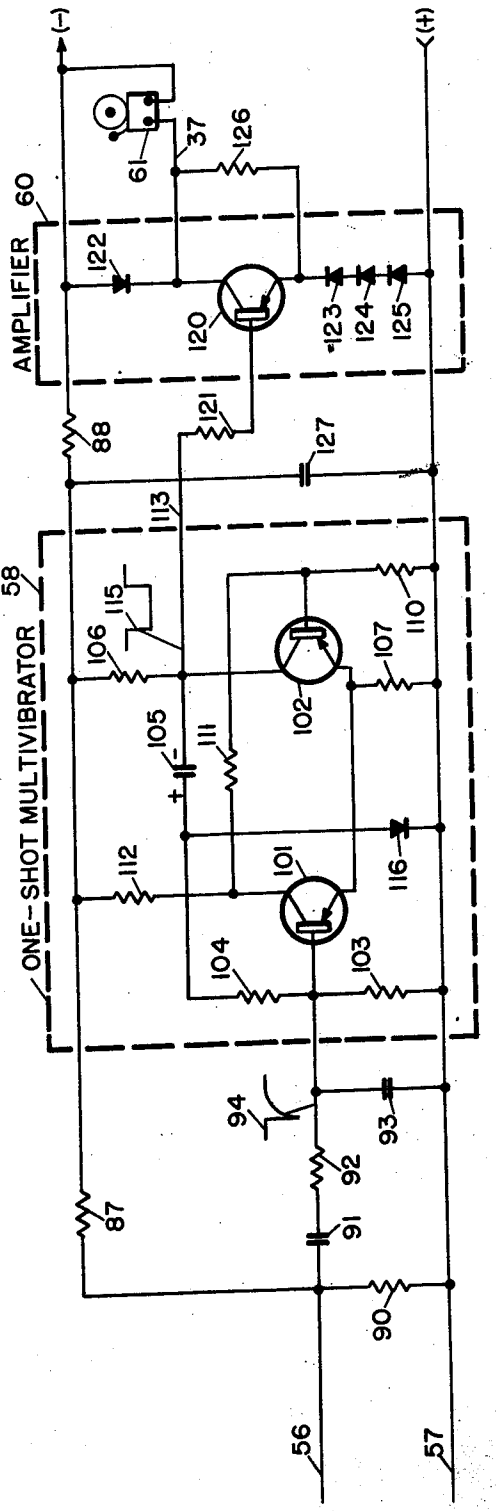


FIG. IC

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United States Patent Office 3,128,455 Patented Apr. 7, 1964

3,128,455

INDICATION SYSTEM AND STORAGE APPARATUS

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Filed Nov. 24, 1961, Ser. No. 154,447
8 Claims. (Cl. 340—213)

The present invention relates to an improved means for indicating various conditions at a remote location, and more particularly to an improved system and apparatus for causing the indication at a central office of traffic governing devices and track occupancy of a stretch of railway track remotely located from the central office.

In centralized traffic control systems, a code is transmitted from a field station to cause visual and audible indications at a central office, which indications are characteristic of the occupancy or non-occupancy of sections of railway track and the operated positions of the various switches, for example. This code, referred to as an indication code, is comprised of a series of digits, with each digit being assigned a specific track section or switch. Thus, the conditions of a plurality of traffic governing devices and occupancy of various track sections for a particular field station are transmitted to the central office in a complete indication code cycle. At the central office a bank of relays is provided whereby each relay thereof is operated in response to a particular digit of the cycle. An indication circuit is provided which includes a front contact of each relay of the bank to illuminate a lamp or sound a buzzer as the case may be to provide the required indications. The character of the energy applied through a contact of an operated relay of the bank for each respective digit indicates the condition of its associated apparatus. For example, the application of positive energy to the indication circuit through a front contact of one relay of the bank may indicate the occupancy of a certain track section, and the application of negative energy to the indication circuit through a front contact of the same relay causes a non-occupancy indication of the track section.

Heretofore, in centralized traffic control systems, a so-called magnetic stick relay was provided for each relay of the bank of relays. These magnetic stick relays were of the type wherein the application of positive energy to its control winding caused its contacts to be operated to one position, and the application of negative energy to its control winding caused its contacts to be operated to the other position. In instances where visual indication was required, a contact of the magnetic stick relay completed a circuit for illuminating a lamp. In instances where a buzzer or a bell was to be sounded momentarily, such as to indicate audibly the entrance of a train into the territory, a combination of relays was provided which included a slow drop-away relay for causing such momentary actuation.

Because of the required reliability in centralized traffic control systems, the magnetic stick relays were necessarily precise in their construction and relatively bulky. Also, these magnetic stick relays required comparatively high energy level signals to insure their reliable operation.

One of the objects of the present invention is to provide an improved system for indicating the operated positions of traffic governing devices, and track occupancy in a centralized traffic control system.

Another object of this invention is to provide an improved indication system for centralized traffic control which can be incorporated in centralized traffic control systems now in use.

Another object of this invention is to provide a system which maintains the reliability of the previous systems

without the necessity of the application of high energy and the undue consumption thereof.

A further object of this invention is to provide an indication system employing an improved bistable storage device which provides a fast response time in response to a low level of input energy.

A still further object of this invention is to provide an improved bistable storage device which is reliable at low energy levels and operates to one condition in response to an input pulse of one polarity and operates to its other condition in response to an input pulse of opposite polarity.

Other objects of this invention will become apparent from the specification, the drawings, and the appended claims.

In the drawings:

FIGS. 1A, 1B and 1C, when placed end to end, illustrate fragmentarily and diagrammatically a centralized traffic control system for a track layout showing schematically one embodiment of the present invention.

To simplify the illustration and facilitate in the explanation of this invention, the various parts and circuits have been shown diagrammatically and conventional symbols have been employed. The drawings have been arranged to facilitate in the principles and manner of operation rather than to illustrate the specific construction and arrangement of parts that would normally be used in practice. The symbols (+) and (−) represents the positive and negative terminals of a low level source of energy respectively.

The illustrated embodiment of the invention is shown in connection with the well known centralized traffic control system such as is disclosed in Patent No. 2,399,734, issued May 7, 1946, to W. D. Hailes, and to which reference may be made for a more detailed description thereof. Such a system is generally shown fragmentarily to illustrate the co-operation of parts in the indication portion of the system in accordance with the present invention. Referring to the drawings, FIG. 1A illustrates a plurality of field stations connected by line wires L1 and L2 to a central office. Field station 3 is shown connected to a track layout which includes track sections TS1 and TS2, and a switch SW3. Track relays T1 and T2, which are energized when their respective track sections are unoccupied; and a relay 3NCR, which is energized when the switch is in a normal position are connected in the well known manner to switch and signal control apparatus which determines the character of assigned digits of the indication cycle which is transmitted over the line wires L1 and L2 by way of the code transmitter for field station 3.

The indication code cycle, which is comprised of a series of long and short pulses is initiated by a change in condition of the relays T1, T2, or 3NCR, for example. In response to such change in condition, a conventional control office coding relay F is operated to energize a relay CF, which is held energized during the indication cycle, by a circuit which includes a front contact of a conventional SA relay in a well known manner. The picking up of the CF relay causes a relay LED to be energized. After the cycle has been initiated in a manner as disclosed in the aforementioned patent, the LED relay is released during those even digits of the cycle which are comprised of a long pulse and held energized during those even digits which are short pulses in the code cycle. The operated condition of the relay LED controls the distinctive output on each even digit of the indication cycle. A group of coding relays V1 through V8 are connected in a well known manner to be energized successively in response to each even digit. Thus, it can be seen that during digit No. 10 of the cycle, the relay V5 is energized, and during digit No. 12 of the cycle the relay V6 is ener-

gized, and during digit 14 of the cycle the relay V7 is energized.

Assuming, for example, that the condition of the track switch SW3 is assigned to the tenth digit of the cycle, and the condition of track section TS1 is assigned to the twelfth digit, and the condition of the track section TS2 is assigned to the fourteenth digit, their respective conditions of occupancy or operation are transmitted to the control office upon each of the respective digits. For example, if the track switch SW3 is operated to normal, the indication code provides a long pulse for the tenth digit of the cycle. This causes positive energy of twenty-four volts, for example, to be applied to a wire 30 (FIG. 1B) during this digit by a circuit which extends from (+) which is twenty-four volts, for example, and includes front contact 32 of the relay CF, back contact 33 of the relay LED, front contact 34 of the relay CF, back contact 33 of the relay LED, front contact 34 of the relay FA, back contact 35 of the relay FAE, wire 36, back contact 37 of the relay V8, back contact 38 of the relay V7, back contact 40 of the relay V6, front contact 41 of the relay V5, and the wire 30. If the track switch SW3 was in a reverse position during the transmission of a particular indication cycle, the tenth digit of the cycle would be a short pulse and negative potential would be applied to the wire 30 during the reception of this digit. The circuit for applying negative potential to the wire 30 extends from (−), which is twenty-four volts, for example, and includes front contact 42 of the relay CF, front contact 33 of the relay LED, the front contact 34 of the relay FA, and so on, over the previously described circuit to the wire 30. The occupancy and non-occupancy of the track section TS1 determines the operated condition of the relay LED during the twelfth digit of the cycle. Thus, if the pulse is a long pulse during this digit indicating occupancy of the track section TS1, positive energy is applied to a wire 45 over the front contact 40 of relay V6, and if the track section is unoccupied negative energy is applied to the wire 45 for the twelfth digit of the cycle. In a similar manner the occupancy of track section TS2 is transmitted to the control office by a long pulse during the fourteenth digit of the cycle to apply a positive potential to the wire 46 thereby causing the storage unit 54 to illuminate a lamp E3; and the non-occupancy of the track section TS2 results in the shutting off of the lamp E3. The lamps E1, E2, and E3 when impressed with a nominal voltage of twenty-four volts, for example, will draw a current of approximately 35 milliamperes.

The storage units 52 and 54 are connected to a so-called coupling unit 55 which is connected by wires 56 and 57 to a one-shot multivibrator 58 (FIG. 1C). The multivibrator 58 is connected at its output to an amplifier 60 which switches on the energy for operating a bell or buzzer 61. When either the storage unit 52 or 54 has positive energy applied thereto to cause its respective lamps E2 and E3 to illuminate, the bell 61 is operated for a short period of time in response thereto.

Referring to FIG. 1B the storage unit 50 is comprised of a silicon controlled rectifier 62. The rectifier 62 is a solid state three terminal device having characteristics similar to a thyratron tube. This rectifier has its anode terminal A connected through the lamp E1 to a source of positive potential which may be twenty-four volts, for example, and also through a diode 63 and a capacitor 64 having a value of ten microfarads, for example, to the front contact 35 of the relay 3ST. The rectifier 62 has its cathode terminal C connected through a resistor 65 of 100 ohms, for example, to the negative terminal of the above twenty-four volt source, for example. A resistor 66 having a value of 1,000 ohms, for example, and a resistor 67 having a value of 2,200 ohms, for example, are connected in series from the negative terminal of the source voltage to a junction going between the capacitor 64 and the front contact 35 of the relay 3ST. The rectifier 62 has its gating terminal G connected through a resistor 68 having a value of 100 ohms, for example, to a junction point between the resistors 66 and 67. A resistor 70 having a value of 10,000 ohms, for example, is connected in parallel with the capacitor 64; and a capacitor 71 having a value of ten microfarads, for example, is connected in parallel with the resistor 66. A resistor 72 having a value of 2,200 ohms, for example, is connected across the anode and cathode terminals A and C respectively of the transistor 62. This resistor 72 along with the resistor 65 in series provides the proper bias at the junction for the cathode C of the rectifier 62 when the lamp E1 is lighted. On the other hand, when the lamp E1 is turned off the potential at the junction of these resistors provides a hold-off bias to the cathode C terminal of the transistor 62. The capacitor 73 having a value of 100 microfarads, for example, is connected at one side to the cathode terminal of the transistor 62 and at its other side to the negative terminal so that the cathode does not respond rapidly to changes in potential caused by a change in the current flow through resistor 65. The gating terminal G of the rectifier 62 is biased by the negative potential of a circuit which includes the resistor 68 and the resistor 66 which is connected to the source of negative potential. Thus the resistors 68 and 66 in series provide the gate with a negative hold-off bias when no pulse of energy is present at the input to the storage device 50. The anode A is biased positive with respect to its cathode C of the rectifier 62 since it is connected directly through the lamp to the positive potential of the source.

When a positive potential is applied through the front contact 35, the capacitor 71 is charged by a circuit which includes the resistor 67, the capacitor 71 and the negative terminal of the source, When the voltage across the capacitor 71 reaches the value of the rectifier gate-to-cathode break over voltage, the gate will trigger and gate current will flow through the resistor 68. Within approximately one microsecond after the gate-to-cathode breakdown the rectifier triggers to conduct, and load current flows between the anode and cathode. The conduction of the transistor 62 illuminates the lamp E1 by a circuit which extends from the positive terminal of the source through the lamp E1 the transistor 62, the resistor 65, and thence to the negative terminal of the source. The resistor 68 limits the gate current to a safe value. The prime function of the capacitor 71 is to absorb the transient spikes of voltage which may appear on the front contact 35 from firing the rectifier 62 inadvertently.

Once the rectifier 62 conducts by the application of the positive potential to the triggering electrode G, it continues to conduct until the load current drops below the value that is required to sustain conduction. While the rectifier 62 is conducting, a small positive voltage appears at its anode and gate terminals of approximately the same value. Thus, the capacitor 64 will be discharged and approximately the same voltage will eventually appear across its plates.

When the switch SW3 operates to its reverse position the tenth digit of the indication code cycle provides a momentary pulse of negative energy to the wire 30 through front contact 35 to the input of the storage unit 50. This momentary application of negative potential charges the capacitor 64 and causes the anode A of the rectifier 62 to be driven negative by the negative potential applied through resistor 70 so that the diode 63 can discharge the positive potential on the anode. This causes current to be drawn out of the rectifier 62 circuit so that its aforementioned sustaining current can no longer be maintained, therefore the rectifier 62 ceases conduction. When the anode of the rectifier 62 is thus driven negative with respect to its cathode a reverse current flows from the charged capacitor 73 through the resistor 72, the diode 63, and the capacitor 64 which speeds up the turn-off time of the rectifier 62. The capacitor 64 prevents false flashing of the lamp E1 if the lamp is turned off when a pulse of negative potential is momentarily applied

to the front contact 35 during the normal stepping operation.

The storage units 52 and 54 are identical in structure and operation to the storage unit 50 previously described. In addition, a wire 75 is connected to the anode terminal A of a silicon-controlled rectifier 76 of the storage unit 52; and a wire 77 is connected to the anode terminal A of a silicon-controlled rectifier 78 of the storage unit 54. The wires 75 and 77 serve as an input to a coupling unit 55. This unit is comprised of two coupling circuits to enable a single bell and buzzer to be operated from the output of the coupling unit. Thus, the coupling unit 55 connects the output wires 75 and 77 from the solid state indication storage units 52 and 54 respectively to a common output wire 56.

The coupling unit 55 is comprised of a capacitor 80 having a value of 0.1 microfarad, for example, and a diode 81 which are connected in series from the wire 75 to the wire 56. The wire 77 from the storage unit 54 is connected to a capacitor 82 having a value of 0.1 microfarad, for example, a diode 83 of the coupling unit 55, thence to the wire 56. The positive side of the diode 83 is connected in common with the positive side of the diode 81 to the wire 56 which is the output of the coupling unit 55. A pair of series-connected resistors 84 and 85 each having a value of 10,000 ohms, for example, are connected at one side to the capacitor 80 and the negative side of the diode 81 and at their other end to the capacitor 82 and the negative side of the diode 83. The positive terminal of a source of energy (FIG. 1C) such as twenty-four volts, for example, is connected to the junction point between the resistors 84 and 85 by the wire 57. The wire 56 is connected to the negative terminal of a source of potential such as twenty-four volts, for example, through a resistor 87 and a resistor 88 connected in series. Typical values for the resistors 87 and 88 are 22,000 ohms and 47 ohms respectively. A resistor 90 having a typical value of 10,000 ohms is connected across the wires 56 and 57. The D.C. voltage level on the wire 56 is determined substantially by the ratio of the value of the resistors 87 and 90. The resistor 88 is negligible in this respect. Thus, the resistors 87 and 90 are in effect connected across the positive and negative terminals of the supply voltage. If the supply voltage is twenty-four volts, for example, and the resistor 90 is approximately one-half the value of the resistor 87, then approximately eight volts appears across the resistor 90. When no current is flowing through the resistors 84 or 85, the cathode terminal of the diodes 81 and 82 respectively have a potential of twenty-four volts positive applied thereto. The anode or positive terminals of the diodes 81 and 83 have a potential of plus eight volts applied thereto over the wire 56. Thus, the diodes 81 and 83 are back biased by 16 volts. Therefore, a negative-going voltage greater than sixteen volts is required for the diodes 81 and 83 to conduct, or in other words, pass a negative-going pulse beyond this value. This prevents the inadvertent conducting of the diodes 81 and 83 whenever a negative input is applied to the storage devices or whenever extraneous noise pulses having an amplitude less than sixteen volts appear on the wires 75 and 77 respectively. The resistors 84 and 85 are each of such a value that they match the resistance of the resistor 90 and also the input resistor 103 of the one-shot multivibrator 58 is made to match this resistance.

A capacitor 91 having a value of one (1.0) microfarad, for example, is used in conjunction with resistors 92 and 103 to provide a differentiation circuit. A typical value for resistor 92 is 4,700 ohms and a typical value for resistor 103 is 10,000 ohms. Normally a differentiated voltage in a simple differentiating circuit would be taken off at the junction of the capacitor 91 and resistor 92, however, in this case the differentiated voltage is taken off at the junction of resistors 92 and 103 and applied to the base terminal of the transistor 101. The fact that the voltage is taken off between the resistors does not alter the wave form but simply divides it down in amplitude. In this instance the voltage applied to the base would be approximately two-thirds of the over-all voltage which exists at the junction between the capacitor 91 and the resistor 92. When a negative-going impulse is applied to the input wire 56 of this network, a sharp negative-going spike results which decays with a relatively long time constant. If any sharp voltage spikes in the form of noise impulses are superimposed on the input wire 56, they may also cause sharply differentiated wave forms provided they are of sufficient time duration; however, these noise impulses are generally of very short duration. In order to eliminate the effects of noise which may possibly inadvertently switch the one-shot multivibrator 58 or more specifically cause transistor 101 to become conductive, an integrating network composed of resistor 92 and a capacitor 93 having a value of 0.01 microfarad, is provided. Any voltage which appears at the input of this integrating network which has a short time duration or a high frequency will be dropped across the resistor 92 and by-passed to the positive terminal of the source through capacitor 93; however, the low frequency will not be substantially affected or by-passed by the capacitor 93. Consequently, only a low frequency impulse will be effective to turn "on" the transistor 101.

Upon the application of a positive pulse over the front contact 51 connected to the input of the storage unit 52, the rectifier 76 is gated as previously described, causing it to conduct. When it conducts, a drop in voltage occurs at its anode terminal A which causes a negative-going step in the voltage present on the wire 75. This negative-going step, is differentiated by the capacitor 80 and the resistor 84 thereby producing a wave form on the wire 56 similar to that referred to at 94 (FIG. 1C). It is this differentiated pulse which operates the one-shot multivibrator 58. It is apparent that when a positive input is applied through the front contact 53 at the input of the storage unit 54, the rectifier 78 conducts and a drop in voltage occurs at its anode terminal A for producing a negative step on the wire 77. The capacitor 82 and the input resistor 84 form a differentiating network to produce on the wire 56 a negative-going waveform such as is referred to at 94. When a negative pulse is applied to the storage units 52 or 54 for shutting off its respective rectifier 76 or 78, the back bias previously mentioned prevents the respective diodes 81 or 83 from conducting and the shutting off of the rectifiers 76 or 78 increases the positive potential at their respective anode terminals A which does not affect the operation of the one-shot multivibrator 58, because this positive-going impulse cannot pass through the diodes 81 and 83.

The one-shot multivibrator 58, which is comprised of PNP transistors 101 and 102, operates as a conventional 300 millisecond one-shot multivibrator. It is triggered by the negative-going leading edge of the waveform 94 on the input wire 56. When no input voltage is present, the transistor 101 is normally non-conducting and the transistor 102 is conducting. The transistor 101 is maintained non-conductive by the positive bias on its base terminal with respect to its own emitter. The base terminal of the transistor 101 is substantially at the positive potential of the supply voltage because there is substantially no current flowing in resistor 107, which has a typical value of 22 ohms, for example. The conducting of the transistor 102 causes current to flow from the positive terminal of the source or wire 57, through resistor 107, the emitter-collector terminals of the transistor 102 through resistor 106 (typically 560 ohms) thence substantially to the negative terminal of the source. (It was formerly stated that resistor 88 is of very low value.) This causes a small voltage drop across the resistor 107. Also, the emitter terminal of the transistor 101 is at the same potential as the emitter of the transistor 102, which may be in the neighborhood of one volt or less than the value of the positive potential of the source. The base

of the transistor 102 is biased negatively by a circuit which extends from the positive terminal of the voltage source and includes resistor 110, resistor 111, resistor 112, resistor 88 and the negative terminal of the voltage source. Typical values of these resistors are 10,000 ohms, 4,700 ohms, 560 ohms and 47 ohms, respectively. The voltage at the base terminal of transistor 102 will be approximately 15 volts below that of its emitter by this voltage divider network. This causes the transistor 102 to remain in a normal state of conduction. The conducting of the transistor 102 also provides a substantial voltage drop across the resistor 106 because it has a value considerably larger than the resistor 107. Thus, the potential on output wire 113 to the amplifier 60 is normally a few volts below the maximum positive potential of the source, and consequently a relatively low potential is present across the capacitor 105.

When a negative-going pulse, such as 94, is supplied to the base of the transistor 101, the base is driven more negative than its emitter which causes the transistor 101 to conduct. The conducting of the transistor 101 causes its collector terminal to become positive as determined by the value of the resistors 107 and 112 whereby the resistor 107 is considerably smaller than the resistor 112. This causes the collector terminal of the transistor 101 to acquire a potential very near to the maximum positive potential of the source. The base terminal of the transistor 102 will acquire a potential also very near to the positive potential of the source for it is divided down by the resistor network of 111 and 110. Thus, the potential of the base of the transistor 102 becomes more positive than its emitter terminal which causes it to become nonconductive. The shutting off of the transistor 102 causes the potential on the output wire 113 to become more negative thereby causing a negative-going step in voltage to appear on the wire 113. The negative-going step charges the capacitor 105 having a value of 50 microfarads, for example, negatively so that its opposite side becomes more positive as governed by the series-connected resistors 103 and 104 the latter having a typical value of 4,700 ohms, for example, connected to the positive side of the capacitor 105 and the resistor 106 connected to its negative side and to the negative source of potential. When the capacitor 105 is charged at its positive side as determined by the time constant of the resistors 103, 104, and 106, it gradually drives the base of the transistor 101 more positive, until finally it is caused to return to the normal state of non-conduction. The shutting off of this transistor causes the bias on the base of the transistor 102 to become more negative to return the transistor to its normal state of conduction. This causes the negative pulse on the wire 113 to terminate and return to its normal positive potential. In response to the operation of the one-shot multivibrator previously described, a negative pulse of a duration determined by the timing of the multivibrator 58 appears at the output wire 113 and is referred to at 115. Diode 116 connected to the positive side of the capacitor 105 and the wire 57 prevents any sharp spike voltages from charging the capacitor 105 above the source of positive potential. In other words, because the diode 116 prevents the potential at the positive side of the capacitor 105 from becoming more positive than the potential on the wire 57, the diode 116 in effect maintains the positive-going step equal in amplitude to the negative-going step in voltage.

The amplifier 60 is comprised of a transistor 120 which is caused to conduct in response to the negative output from the multivibrator 58 on its wire 113 when the multivibrator 58 is triggered. The transistor 120 of the amplifier 60 has its base terminal connected through a resistor 121 to the output wire 113, its collector terminal connected through the bell 61 to the negative source of potential, and its emitter terminal connected through diodes 123, 124, and 125 to the source of positive potential. A reverse connected diode 122 is connected in the collector circuit from the collector terminal of the transistor 120 to the negative terminal of the source. A resistor 126 is connected across the emitter and collector terminals of the transistor 120. When the transistor 120 conducts, a current flows from positive potential through the diodes 125, 124, and 123, through the transistor 120, through the winding of the bell 61 to the negative terminal. Since the conduction of the transistor 120 is maintained only for the duration of the negative pulse 115, the bell 61 operates only for the duration of this pulse voltage. The diode 122 is provided to unload the induction effect of the back E.M.F. of the bell winding. The resistor 126 provides the bias on the emitter terminal of the transistor 120. The resistor 88, which is of relatively small value, and a capacitor 127 provides a decoupling network to prevent any power supply transients from triggering the one-shot multivibrator 58 inadvertently. These transients are absorbed by the capacitor 127 rather than being applied through the resistor 87 which may cause the inadvertent triggering of the transistor 101.

Thus, in summary, whenever the switch SW3 is operated to its normal position, for example, the storage unit 50 causes the lamp E1 to illuminate. When the track section TS1 or TS2 becomes occupied, the respective storage units 52 or 54 causes its associated lamp E2 or E3 to be illuminated. Simultaneously, with the illumination of either of the lamps E2 or E3, the bell 61 is sounded momentarily to call this fact to the attention of the operator. Although only one coupling unit 55 is illustrated and described, it is apparent that other coupling units from other storage devices could be added to drive the bell 61 in accordance with the individual requirements of practice, for example, ten storage units such as 52 and 54 may operate the bell 61 by providing five coupling units. Although certain examples of values have been given in connection with the description and present invention, it is understood that other values could be provided in accordance with the requirements of practice, for example, other load currents for the storage units 50, 52, and 54 may be provided by adjusting the bias on the cathode terminals of their respective rectifiers 62, 76, and 78, or, silicon diodes or other means could be connected across the biasing resistor, such as 65 of the storage unit 50.

Thus, having shown and described an improved indication system and storage unit according to one specific embodiment of the invention, it is understood that modifications and adaptions may be made without departing from the spirit or scope of the present invention.

What I claim is:

1. In a centralized traffic control organization for indicating the condition of a single piece of apparatus in response to the character of each digit of an indication code cycle having a series of digits, and for causing simultaneously two indications for a single selected piece of apparatus wherein an output voltage of opposite polarities is selectively applied to an output circuit for each individual digit, the combination of an electronic storage device for each output circuit of an indication code cycle, each said storage device having an anode and cathode and gating electrode, circuit means connecting each of said storage devices to a respective output circuit to govern said storage device to conduct in response to an output voltage of one polarity and to govern said storage device to cease conducting in response to an output voltage of opposite polarity, a first indication means connected to each of said storage devices operated to one condition in response to the conducting of its storage device and to another condition in response to the non-conducting of its respective storage device, a coupling circuit means connected to selected pairs of said storage devices operative to pass an effective voltage pulse in response to the application of an output voltage of said one polarity only to its respectively connected storage devices, a mono-stable multivibrator electrically connected to said coupling circuit means operated in response to said effective voltage

pulse from said coupling circuit means, and a second indication means responsive to the operation of said monostable multivibrator.

2. In a centralized traffic control organization as claimed in claim 1 wherein the cathode of each storage device is biased negatively with respect to its anode, and the storage device is governed to conduct in response to a voltage of positive polarity and cease conducting in response to a voltage of negative polarity, and each first indication means is connected in series with the anode and cathode of its storaged device.

3. In a centralized traffic control organization for indicating the condition of a single piece of apparatus in response to the character of each digit of an indication code cycle having a series of digits and for causing simultaneously two indications for a single selected piece of apparatus wherein an output voltage of opposite polarities is selectively applied to an output circuit for each digit of a cycle in accordance with the character of each individual digit, the combination of a semi-conductor for each output circuit having an anode and cathode and gating electrode a unidirectional current conducting device electrically connected at one side to the anode of each semi-conductor, a first indicating element electrically connected at one side to the common connection of a respective semi-conductor and its unidirectional device and electrically connected at its other side to a source of positive potential, a first resistance element electrically connected between a negative source of potential and the cathode of each said semi-conductor for limiting the current flow through said semi-conductor, a second resistance element electrically connected across the anode and cathode of each semi-conductor for maintaining a biasing potential on its respective cathode, a first capacitive element connected at one side to the negative source of potential, a third resistive element coupling the other side of the first capacitive element to the gating terminal of each semi-conductor, a series connected fourth resistive element and a second capacitive element coupling said other side of the first capacitive element to said other side of each associated unidirectional device, means electrically connecting an output circuit to the junction of each second capacitive element and its fourth resistive element for selectively applying a positive and negative potential thereto, whereby the application of positive potential from each output circuit is operative to trigger its semi-conductor into conduction and the application of a negative potential is operative to govern its semi-conductor to cease conduction, a coupling circuit means having a plurality of inputs and a single output, means electrically connecting each of said inputs to the anode of a respective semi-conductor to pass an effective voltage pulse at its single output in response to a positive potential to each junction of the second capacitive element and the fourth resistive element, a monostable multivibrator electrically connected to the output of said coupling circuit means operated in response to each effective voltage pulse, and a second indicating element responsive to the operation of said multivibrator.

4. A circuit organization for operating to one state in response to an input voltage of one polarity and to another state in response to an input voltage of opposite polarity, comprising a semi-conductor having an anode and cathode and gating electrode, a unidirectional current conducting device electrically connected at one side to the anode of said semi-conductor, a loading element electrically connected at one side to the common connection of said semi-conductor and unidirectional device and electrically connected at its other side to a source of positive potential, a first resistive element electrically connected between a negative source of potential and the cathode of said semi-conductor for limiting the current flow through said semi-conductor, a second resistive element electrically connected across the anode and cathode of said semi-conductor for maintaining a biasing potential on said cathode, a first capacitive element connected at one side to the negative source of potential a third resistive element coupling the other side of the first capacitive element to the gating terminal of each semi-conductor, a series connected fourth resistive element and a second capacitive element coupling said other side of the first capacitive element to said other side of said unidirectional device, input means electrically connected to the junction of said second capacitive element and said fourth resistive element for selectively applying a positive and negative potential thereto, whereby the application of negative potential to said input means is effective to govern said semi-conductor to change from a conducting to a non-conducting state.

5. A circuit organization according to claim 4 wherein said loading element is a lamp that illuminates in response to the conducting of said semi-conductor and shuts off in response to the non-conducting of said semi-conductor.

6. A circuit organization according to claim 4 further including an indicating element, a gating means, circuit means connecting the anode of the semi-conductor to the gating means to operate the gating means in response to the application of an input voltage of one polarity only to the junction of said second capacitive element and said fourth resistive element, and means connecting the indicating element to the gating means to operate the indicating means in response to the operation of the gating means.

7. A circuit organization according to claim 6 wherein said circuit means includes a differentiating circuit means to produce a voltage spike in response to a pulse of said one polarity, and said gating means is a monostable multivibrator operated in response to said voltage spike.

8. A circuit organization for operating a first and second indicating means in response to an input voltage pulse of one polarity and for operating the first indicating means only in response to an input voltage pulse of opposite polarity, comprising an electronic storage device including an anode and cathode and gating electrode, means to apply selectively a voltage pulse of opposite polarities, first circuit means connecting said storage device to the application means to govern said storage device to conduct in response to a voltage pulse of one polarity and to govern said storage device to cease conducting in response to a voltage pulse of opposite polarity, a first indicating means connected to the storage device operated to one condition in response to the conduction of the storage device and operated to its other condition in response to the non-conduction of said storage device, a second indicating means, and second circuit means connecting said storage device to the second indicating means to operate the second indicating means to its one condition in response to an input voltage pulse by said application means of one polarity only to the storage means, said second circuit means including timing means to operate the second indicating means to its other condition a predetermined time interval after its operation to said one condition.

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