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G. C. SUMMERS

3,479,641

SEQUENTIAL DIRECTION INDICATOR

Filed March 11, 1968

2 Sheets-Sheet 1

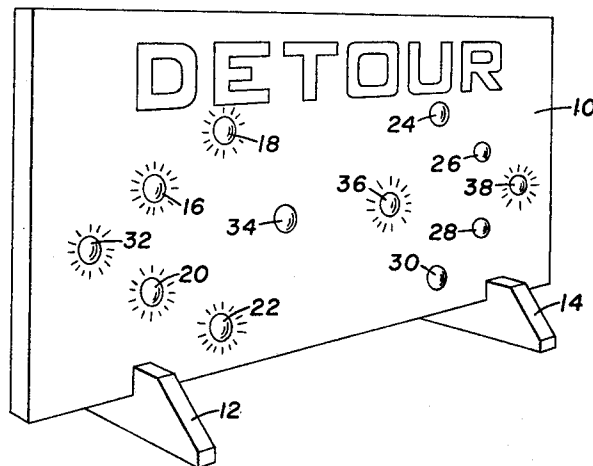


FIG. 1

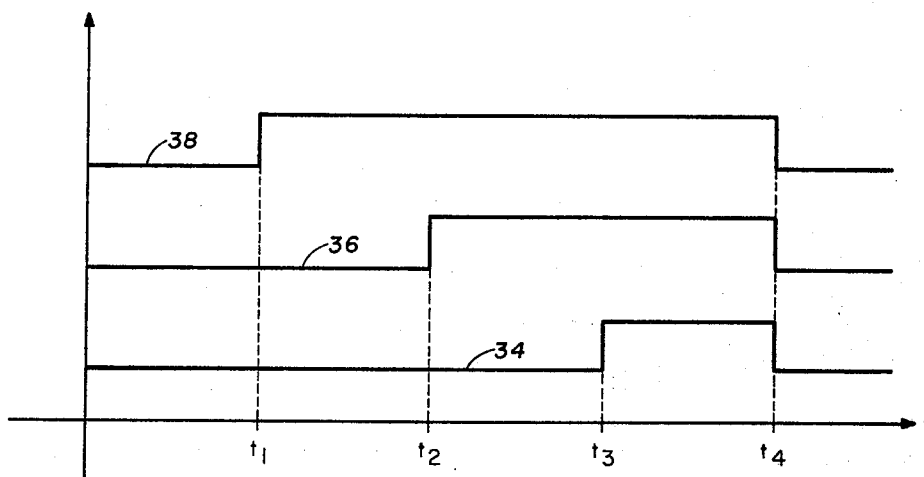


FIG. 3

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2 Sheets-Sheet 2

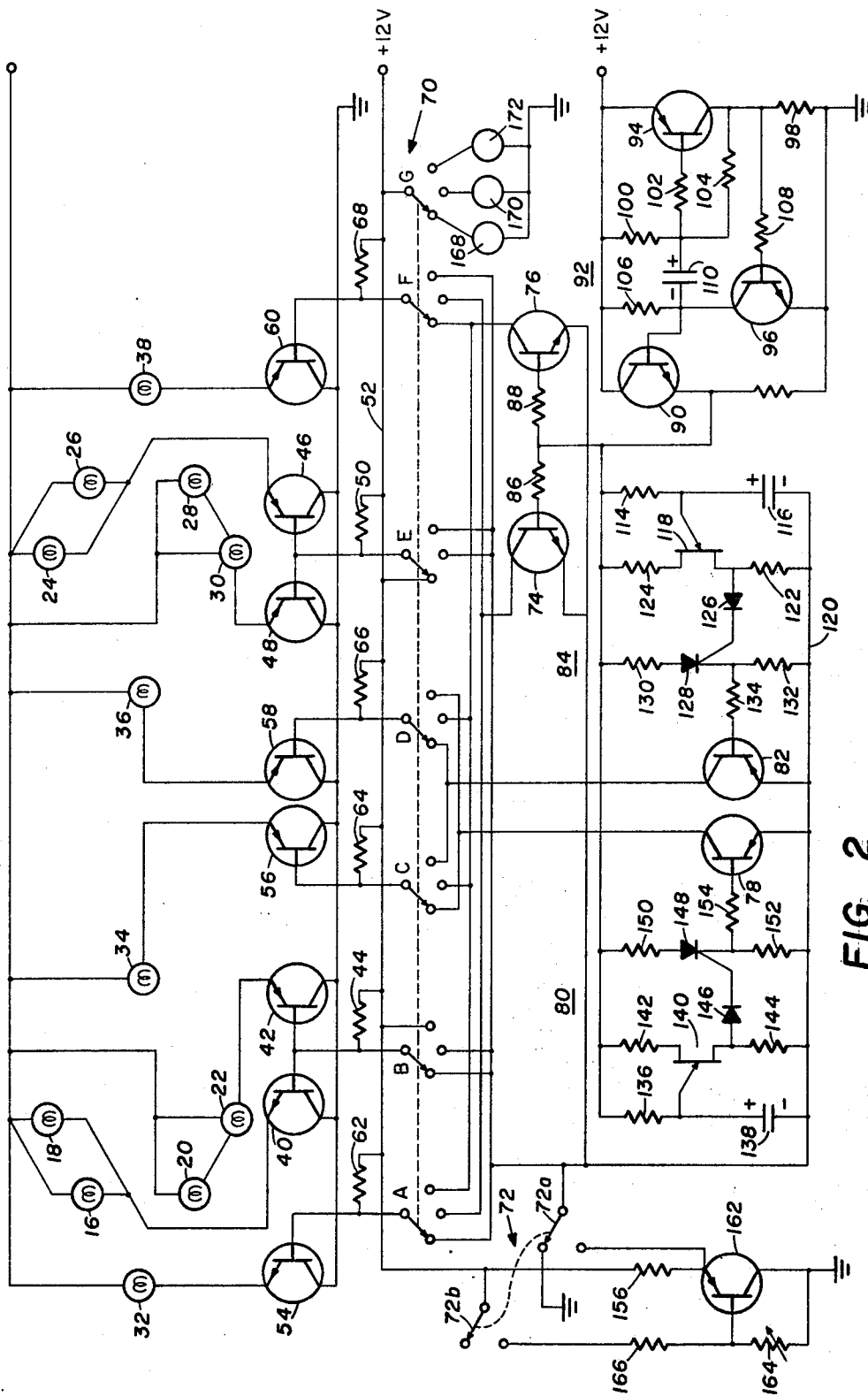


FIG. 2

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SEQUENTIAL DIRECTION INDICATOR

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15 Claims

ABSTRACT OF THE DISCLOSURE

A single or dual direction indicator including light sets arranged in opposed arrowhead configurations and an arrow shaft common to both arrowheads. Each light set in the arrangement is energized by means of individual switching transistors having base drive voltages coupled through a three-position switch to timing signals. The timing signals are generated by a timing module and unijunction transistor multivibrator slave modules. To indicate one of two opposed directions, one of the arrowhead light arrangements is continuously energized and the arrowshaft sequentially energized. For dual direction signaling, the complete light arrangement is coupled to the timing module and flashes at periodic intervals.

BACKGROUND OF THE INVENTION

The invention relates to a sequential direction indicator, and more particularly to a direction indicator wherein sequential flashing lights signal a desired direction.

There are many applications where it is desired to convey a message of anticipated direction change or to signal others to change directions. In road construction and repair, a direction change is often required in the form of a detour around the construction or repair area. A commonly used detour sign is the type constructed from reflectorized materials which are illuminated by auto headlights or the like. However, with present high speed travel on modern freeways, reflectorized signs may not provide adequate warning time. One system for providing adequate warning in advance of a detour is to illuminate a direction arrow which will be visible beyond the headlight distance. Unfortunately, driving hypnosis often leads to a state of semiconsciousness and the continuously illuminated sign may be overlooked.

In accordance with the present invention, a direction indicator is provided wherein sequentially illuminated lights signal a given direction. It is not so much the light itself that attracts the eye, but rather the intermittent flashing. Where the direction indicator is in the form of an arrow, the arrowhead may be continuously illuminated and a series of lights comprising the arrow shaft are turned on starting with the farthestmost from the arrowhead. This enhances the ability of a viewer to quickly recognize a given direction.

The sequential operation of the light arrangement is controlled by a timing module generating a master signal squarewave and a plurality of slave modules each synchronized in operation by the master signal squarewave. Basically, each slave module includes a unijunction transistor timing circuit generating a gating pulse to a silicon control rectifier. Sequential operation of the indicating lights is controlled by varying the time constant of the unijunction transistor timing circuits.

A feature of the present invention is to provide a direction indicator wherein flashing lights enhance a viewer's ability to quickly recognize a direction signal.

Another feature of this invention is to provide a direction indicator wherein light sets are operated sequentially to further enhance the ability of a viewer to quickly recognize a direction signal.

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SUMMARY

This invention relates to a sequential timing system for direction indication including light means arranged in sets to signal a direction and a timing module for producing a series of master timing signals. A plurality of slave modules each responsive to the start of said timing signals produce individual timing pulses connected to individual sets of said lighting means through switches thereby energizing the light sets in a preselected pattern.

A more complete understanding of the invention and its advantages will be apparent from the specification and claims and from the accompanying drawings illustrative of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 illustrates a fixed position detour sign for indicating one or both of two opposite directions;

FIGURE 2 is an electrical schematic of a sequential control system for the lighting arrangement of the sign shown in FIGURE 1, and

FIGURE 3 is a plot of voltage versus time for three signal waves generated by the circuit shown in FIGURE 2.

DESCRIPTION OF A PREFERRED EMBODIMENT

Although the sign illustrated in FIGURE 1 is of a semipermanent type used in road construction and repair areas, this invention is also applicable to vehicle mounted signs for use in highway maintenance. Also, a sequential direction indicator in accordance with this invention has application to fixed locations such as runway and ramp direction indicators used in routing airport traffic.

Referring to FIGURE 1, there is shown a billboard type sign 10 supported on stands 12 and 14 and containing a light arrangement for indicating both a left and right direction. The arrangement includes light sets 16 and 18 forming an arrowhead with light sets 20 and 22. A light indicating arrowhead is formed by light sets 24 and 26 arranged with light sets 28 and 30. Four individual light sets 32, 34, 36, and 38 are arranged to form a common shaft for the two arrowheads.

Referring to FIGURE 2, the light arrangement is shown schematically with one terminal of each light set connected to a twelve volt direct current supply (not shown). Light sets 16 and 18 are coupled together to ground through a switching transistor 40 and light sets 20 and 22 are coupled together to ground through a switching transistor 42. Transistors 40 and 42 include base electrodes interconnected to a base drive resistor 44 having a second terminal connected to the positive terminal of a twelve volt direct current supply (not shown) by means of a line 52. For the right indicating arrow, the light sets 24 and 26 are coupled together to ground through a switching transistor 46 and light sets 28 and 30 are coupled together to ground through a switching transistor 48. A base drive resistor 50 having one terminal tied to a direct current supply by means of the line 52 establishes the base drive voltage for the transistors 46 and 48. The light sets 32, 34, 36, and 38 are individually coupled to ground through respective switching transistors 54, 56, 58, and 60. A base drive voltage for the transistors 54, 56, 58, and 60 is established by respective base drive resistors 62, 64, 66, and 68. These resistors are all tied to the direct current supply by means of the line 52.

In addition to connecting to a base drive resistor, the base electrodes of the switching transistors are also coupled to a seven-deck, three-position selection switch 70. Deck A of switch 70 connects to the base electrode of transistor 54, deck B to the base electrodes of transistors 40 and 42, deck C to transistor 56, deck D to transistor 58, deck E to transistors 46 and 48, and deck F to the base electrode of transistor 60. The first position of deck A and the first and second positions of deck B along with the

second and third positions of deck E and the third position of deck F are interconnected to pole 72a of a two-pole two-position switch 72. In the position shown, switch 72 grounds the aforementioned interconnection. Position two of deck A is interconnected with position two of deck F, both of which are tied to the emitter electrode of a transistor 74. The third position of deck A and the second position of decks C and D along with the first position of deck F are connected to the emitter electrode of a transistor 76. Position one of deck C and position three of deck D are interconnected to the emitter electrode of a transistor 78 of a slave timing module 80. The third position of deck C and the first position of deck D are interconnected to the emitter electrode of a transistor 82 which is part of a slave timing module 84.

The base electrodes of transistors 74 and 76 are connected through respective base drive resistors 86 and 88 to the emitter electrode of an output transistor 90 which is part of a timing module 92. The timing module 92 is a standard regenerative type oscillator and includes a PNP transistor 94 and an NPN transistor 96. Transistor 94 is emitter biased by a voltage at the positive terminal of a direct current supply (not shown) and connected to ground through a biasing resistor 98. A base drive voltage for the transistor 94 is established by means of a resistance network including a base drive resistor 100 and timing resistors 102 and 104. The transistor 96 is emitter grounded and collector biased by a voltage at the positive terminal of a direct current supply through a resistor 106. A base drive voltage for the transistor 96 is established by the bias resistor 98 and a base drive resistor 108. A timing capacitor 110, connected between the collector electrode of transistor 96 and the timing resistors 102 and 104, completes the timing module 92.

In operation, assume the timing capacitor 110 is in a fully discharged condition and the transistors 94 and 96 are nonconducting. A positive D.C. voltage connected to terminal 112 biases the transistor 94 into a conducting state by a voltage drop developed across the base drive resistor 100. Simultaneously, the transistor 96 turns on when the resistor 98 establishes a voltage at the base electrode which is positive with respect to the emitter electrode. Conduction through the transistor 96 further biases the transistor 94 into a more conducting, or saturated, state by driving the base electrode to a still more negative potential. The current fed from the collector of transistor 96 to the base of transistor 94 cannot long endure, however, for a charge begins to build up in the timing capacitor 110 as current flows through the collector-emitter junction of the transistor 96 and the base-emitter junction of the transistor 94. The length of time a saturation condition prevails in transistor 94 is primarily governed by the values of capacitor 110 and resistor 102. At the instant the current in the base electrode of transistor 94 falls below a value required to maintain saturation, the collector electrode of transistor 94 falls to a ground potential thereby reducing the current in resistor 108 and, thus, in the base electrode of transistor 96. Thereupon, the saturation condition of transistor 96 also ends and, by regeneration, the on period ends for both transistors 94 and 96. The off condition is also unstable, since resistor 104 immediately begins to discharge the capacitor 110 eventually causing the above operation to be repeated. When transistors 94 and 96 are off, the output transistors 90 is conducting and turned on, a positive base current being supplied by resistor 106. This regenerative action continues with the turn off time of the transistor 90 determined by the timing resistor 102 in series with the timing capacitor 110, and the turn on time determined by the timing resistor 104 in series with the timing capacitor.

In addition to applying a positive voltage to the base electrodes of transistors 74 and 76, conduction of transistor 90 also establishes a positive D.C. voltage at the slave timing modules 80 and 84. Slave module 84 includes a timing resistor 114 in series with a timing capacitor 116.

The common junction between the timing resistor 114 and the capacitor 116 ties to the emitter electrode of a unijunction transistor 118. Unijunction transistor 118 includes a base-one electrode tied to a common line 120 through a resistor 122 and a base-two electrode tied to the emitter of transistor 90 through a resistor 124. A diode 126 couples the base-one electrode of the unijunction transistor 118 to the gate electrode of a silicon controlled rectifier 128. The anode electrode of the SCR 128 is interconnected to the emitter of the output transistor 90 through a resistor 130. A resistor 132 connects the cathode electrode of the SCR 128 to the line 120 and a base drive resistor 134 couples the SCR cathode electrode to the base of transistor 82.

The unijunction transistor trigger circuit used in the slave module 84 is a simple relaxation oscillator. In this circuit, the capacitor 116 charges through the resistor 114 until the emitter peak point voltage of the transistor 118 is exceeded. At this time the unijunction transistor turns on thereby discharging the capacitor 116 through the resistor 122. When the emitter voltage of transistor 118 reaches a value of about two volts, the emitter ceases to conduct, the unijunction transistor turns off, and the above cycle is repeated.

Repetition of the above cycle generates a series of equally spaced voltage pulses at the base-one electrode of transistor 118. These voltage pulses are coupled through the diode 126 to the gate electrode of the SCR 128. Applying a positive voltage to the SCR gate electrode with a positive voltage at the anode electrode increases the current flowing through the device (by transistor action), thereby causing the rectifier to go into a high conduction mode of operation. Once the gate has triggered the SCR into the high conduction mode, it no longer controls conduction and the only method of turning off an SCR is to reduce the main current below the holding current level. To turn off the SCR, it is necessary to drive the anode negative or to near zero with respect to the cathode. This is accomplished when the transistor 90 turns off. Thus, the slave module 84 begins its timing sequence when transistor 90 starts to conduct and is reset when transistor 90 becomes nonconducting.

Conduction through the SCR 128 generates a bias voltage at the base electrode of the transistor 82 thereby causing it to go into a conduction mode. The elapsed time between the conduction of transistor 90 and conduction of transistor 82 is determined by the RC time constant of resistor 114 in series with capacitor 116.

Slave timing module 80 is similar in construction and operation to slave module 84; it includes a timing resistor 136 in series with a capacitor 138 tied to the line 120. A unijunction transistor 140 includes an emitter electrode connected to the junction of resistor 136 and capacitor 138, a base-two electrode tied to the transistor 90 through a resistor 142, and a base-one electrode connected to line 120 through a resistor 144. A diode 146 couples the base-one electrode of the transistor 140 to the gate electrode of a silicon controlled rectifier 148. The anode electrode of the SCR 148 connects to the transistor 90 through a resistor 150 and the cathode electrode is tied to line 120 through a resistor 152. A base drive resistor 154 couples the cathode of the SCR 148 to the base of transistor 78. Operationally, the slave timing module 80 is similar to the slave timing module 84.

Line 120 ties the various components of the slave modules 80 and 84 to pole 72a of the two-position switch 72, which in the position shown, connects these components to ground. In the second position, the switch 72 connects the components interconnected to line 120 to a dimmer circuit having resistor 156 tied to the emitter electrode of a transistor 162 as a load. Transistor 162 is biased into various degrees of conduction by means of a variable resistor 164 in series with a resistor 166 connected between the positive terminal of a direct current supply through pole 72b of the switch 72 and ground.

With the switch 72 in the position shown, the switching transistors controlling the light arrangement are driven into near saturation and full voltage is applied to the individual light sets. When the switch 72 is in an alternate position, the switching transistors will operate at various levels of conduction depending on the setting of the variable resistor 164. This condition causes somewhat less than the full supply voltage to be applied to the light arrangement.

For an understanding of the operation of the complete system, assume a set of initial conditions wherein the switches 70 and 72 are in the position shown and the switching transistors 40, 42, and 54 are biased into saturation by a ground potential at the respective base electrodes. Conduction of transistors 40, 42, and 54 energizes the light sets 16, 18, 20, 22, and 32. These light sets are continuously energized as depicted in FIGURE 1. Assume also that at the time the arrowhead is illuminated, transistor 90 is nonconducting. Transistors 94 and 96 are conducting and will continue to conduct so long as the capacitor 110 is charging. When capacitor 110 is fully charged, the transistor 90 conducts, a positive voltage appears at the base electrodes of the transistors 74 and 76, and the timing sequence of the slave modules 80 and 84 commences. A positive voltage at the base electrode of the transistor 76 causes it to conduct thereby forward biasing the transistor 60. Forward biasing transistor 60 energizes the light set 38.

After a predetermined period of time established by the resistor 114 in series with the capacitor 116, the transistor 82 begins to conduct thereby forward biasing the transistor 58. Forward biasing transistor 58 energizes the light set 36. After a second elapsed time, determined by the resistor 136 in series with the capacitor 138, the transistor 78 conducts thereby forward biasing the switching transistor 56. Conduction of the transistor 56 energizes the light set 34. The light sets 16, 18, 20, 22, 32, 34, 36, and 38 are now all energized and form a direction arrow pointed toward the left. These light sets remain energized until the capacitor 110 has discharged to a point where the transistors 94 and 96 again turn on at which time the transistor 90 becomes nonconducting. With the transistor 90 in a nonconducting mode of operation, the transistor 76 is turned off thereby back biasing the transistor 60 and de-energizing the light set 38. Also, when transistor 90 becomes nonconducting, the silicon controlled rectifiers 128 and 148 become back biased thereby turning off the transistors 78 and 82. Turning off the transistor 82 back biases the transistor 58 thus de-energizing the light set 36. Turning off the transistor 78 back biases the transistor 56 and the light set 34 is de-energized. Only the arrowhead remains illuminated at this time.

The above sequence is repeated when the capacitor 110 again becomes fully charged. Referring to FIGURE 3, there is a plot of voltage drop versus time for the light sets 34, 36, and 38. At time t_1 transistor 90 begins to conduct and a voltage drop appears across the light set 38. At time t_2 transistor 82 begins to conduct and a voltage appears across light set 36. Similarly, at time t_3 the transistor 78 begins to conduct and a voltage appears across light set 34. At time t_4 transistor 90 becomes nonconducting and turns off transistors 78 and 82 thereby deenergizing light sets 34, 36, and 38.

Transferring the switch 70 to the third position forward biases the switching transistors 46, 48, and 60 thereby continuously energizing the light sets 24, 26, 28, 30, and 38. Switching transistor 54 is now forward biased by conduction of the transistor 76 at time t_1 to energize the light set 32. Switching transistor 56 is now forward biased by turning on the transistor 82 to energize the light 34 at time t_2 . At time t_3 the switching transistor 58 is turned on through the transistor 78 thereby energizing the light set 36. An arrow pointing in a right direction is illumi-

nated. The light sets 32, 34, and 36 are turned on sequentially as were the light sets 38, 26, and 34 for a left indicating arrow.

Rotating the switch 70 to the middle position forward biases the switching transistors 40, 42, 46, and 48 to continuously energize the light sets 16, 18, 20, and 22, along with light sets 24, 26, 28, and 30. Switching transistors 54 and 60 are now forward biased by operation of the transistor 74 and switching transistors 56 and 58 are forward biased by operation of the transistor 76. Transistors 74 and 76 become conducting simultaneously with conduction of the transistor 90. Thus, with switch 70 in the middle position, the light sets 32, 34, 36, and 38 are turned on simultaneously at time t_1 and turned off at time t_4 .

To indicate the position of the seven-deck, three-position switch 70, pilot lights 168, 170, and 172 are connected to deck G. Although only two slave timing modules are shown in the embodiment of FIGURE 2, any number of such modules may be operated by the transistor 90, within the power capabilities of this transistor. Thus, additional light sets can also be included in the light arrangements.

What is claimed is:

1. A sequential timing system for a direction indicator including lighting means arranged in sets to convey a direction indication comprising:

a timing module for producing a series of master timing signals,

a plurality of slave modules individually connected to said timing module and actuated to begin a timing sequence at the start of said timing signals, thereby producing individual timing pulses,

switching means operatively connected to each of said slave modules for interconnecting individual sets of said lighting means to a power source, said switching means actuated between an "on" and an "off" state by the timing pulses to energize said sets in a pre-selected program, and

second switching means operatively connected to said timing module for interconnecting selected individual sets of said lighting means to a power source, said second switching means actuated between an "on" and an "off" state by the master timing signals to energize the selected sets of lighting means.

2. A sequential timing system for a direction indicator as set forth in claim 1 wherein said slave modules each include a unijunction transistor timing circuit producing gating pulses to a silicon controlled rectifier.

3. A sequential timing system for a direction indicator as set forth in claim 2 wherein said switching means are three-electrode transistors energizing said light sets when a gating pulse turns on said silicon controlled rectifier.

4. A sequential timing system for a direction indicator as set forth in claim 2 wherein conduction through said controlled rectifiers is discontinued at the termination of a timing pulse from said timing module.

5. A sequential direction indicator system comprising: lighting means arranged in sets to convey movement in one of two directions,

means for selecting sets of said lighting means to be continuously energized thereby indicating one of said two directions,

a timing module for producing a series of master timing signals,

a plurality of slave modules individually connected to said timing module to be actuated at the same time to begin an independent timing sequence at the start of each master timing signal, thereby producing separate timing pulse signals, and

a plurality of switching means individually connected to one of said slave modules for interconnecting a selected light set of said lighting means to a power source, said switching means individually actuated between an "on" and "off" state to energize said

light set in a pattern determined by the timing pulses produced by the respective slave module to cooperate with the continuously energized light sets to indicate one of two selected directions.

6. A sequential direction indicator system as set forth in claim 5 wherein said selection means continuously energizes one set of said lighting means and establishes the energizing pattern for said remaining sets.

7. A sequential direction indicator system as set forth in claim 5 including switching means in series with a dropping resistor connected to said switching means for controlling the illumination intensity of said lighting means.

8. A sequential timing system for a direction indicator including sets of lights arranged to indicate one of two directions and having light sets common to both directions comprising:

- means for continuously energizing the light sets indicating one of said two directions,
- a timing module for producing a series of master timing signals,
- a plurality of slave modules individually connected to said timing module and actuated to begin a timing sequence at the start of said timing signals, thereby producing individual timing pulses at increasing time intervals from the start of said timing signal,
- a plurality of transistor switches individually in series with one light set of said arrangement, said transistor switches individually connected to one of said slave modules and actuated between a conducting and a non-conducting state by the timing pulses therefrom to energize said light set when conducting, and means for connecting said slave modules, said energizing means, and said timing module to said transistor switches to energize the light arrangement in a predetermined pattern.

9. A sequential timing system for a direction indicator as set forth in claim 8 including means for controlling the illumination intensity of said light arrangement.

10. A sequential timing system for a direction indicator as set forth in claim 9 wherein each of said slave modules includes a unijunction transistor timing circuit producing gating pulses to a silicon controlled rectifier.

11. A sequential timing system for a direction indicator as set forth in claim 10 wherein said silicon controlled rectifiers are turned off at the termination of a timing signal produced by said timing module.

12. A sequential timing system for a direction indicator as set forth in claim 8 wherein said connecting means includes a three-position switch with one position for energizing said light arrangement to indicate a first direction, a second position for energizing said light arrangement to indicate a second direction, and a third position for indicating both directions simultaneously.

13. A sequential timing system for a direction indicator comprising:

- lighting means arranged in sets to indicate two opposing directions, one of said light sets arranged in the arrowhead configuration to indicate a first direction, another set of said lights arranged in an arrowhead configuration to indicate an opposite direction, and the remaining sets arranged to form an arrow shaft common to both of said arrowhead configurations,
- a plurality of transistor switching means individually connected to separate light sets to cause energization thereof when conducting,
- a timing module for producing a series of master timing signals,
- a plurality of slave modules individually connected to said timing module and actuated to begin a timing sequence at the start of said timing signals, thereby producing a plurality of timing pulses delayed by increasing time intervals from the start of said timing signals, and
- switching means having several ganged decks for separately connecting individual transistor switches to the timing module, individual slave modules, and a voltage source for energizing the arrowhead sets of said light arrangement.

14. A sequential timing system for a direction indicator as set forth in claim 13 wherein said switching means has three positions, one for continuously energizing one arrowhead arrangement and connecting the arrow shaft sets to the timing module and slave modules, a second position for continuously energizing the opposite direction arrowhead arrangement and connecting said arrow shaft set to the timing module and the slave modules, and a third position for connecting the entire light arrangement to said timing module.

15. A sequential timing system for a direction indicator as set forth in claim 14 including an intensity control comprising a transistor switch in series with a dropping resistor.

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