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Doughty

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[54] **STROBE LIGHT SYSTEM FOR TRANSITIONAL GUIDANCE AND DELINEATION**

[75] Inventor: **Frederic C. Doughty,** Tredyffrin Township Chester County, Pa.

[73] Assignee: **Elco Corporation,** Willow Grove, Pa.

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[52] **U.S. Cl.** ..... **315/312,** 174/112, 315/210, 315/313, 315/323, 340/46, 340/82, 340/114 B

[51] **Int. Cl.** **H05b 37/02,** H05b 41/44

[58] **Field of Search** ..... 174/69, 70 R, 70 A, 112; 307/246, 252 M, 293; 315/209 R, 210, 211, 217, 312, 313, 314, 315, 317, 318, 319, 323; 340/41 R, 41 A, 46, 82, 114 R, 114 B, 331, 332, 340, 341

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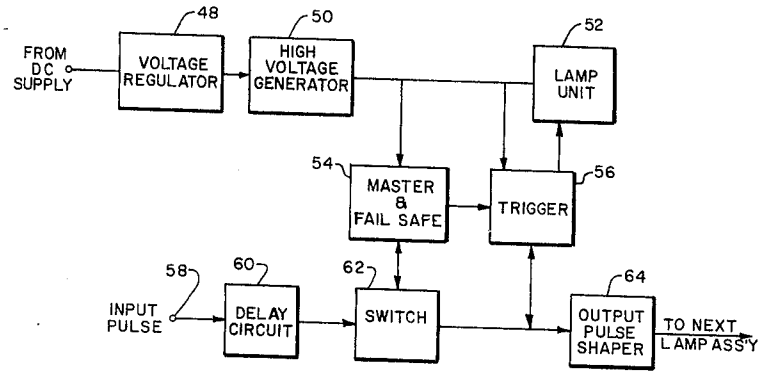
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Primary Examiner—Herman Karl Saalbach
Assistant Examiner—E. R. LaRoche
Attorney, Agent, or Firm—Alan L. Newman, Esq.

[57] **ABSTRACT**

A strobe light system including a plurality of strobe light assemblies which may be positioned along a highway at spaced intervals to provide road delineation, and particularly guidance of vehicular traffic from one lane to another around obstacles such as construction, accidents, and the like. Each strobe light assembly includes a lamp unit and a circuit housing mounted on a portable stand. Circuitry for controlling the flashing of the lamps in master or slave modes, and for providing fail safe operation is mounted in the circuit housing. Each assembly further includes a jumper cable for connection to a primary cable connected to a power source. Each jumper cable includes calibration markings to enable accurate positioning of the assemblies for transitional purposes.

7 Claims, 5 Drawing Figures



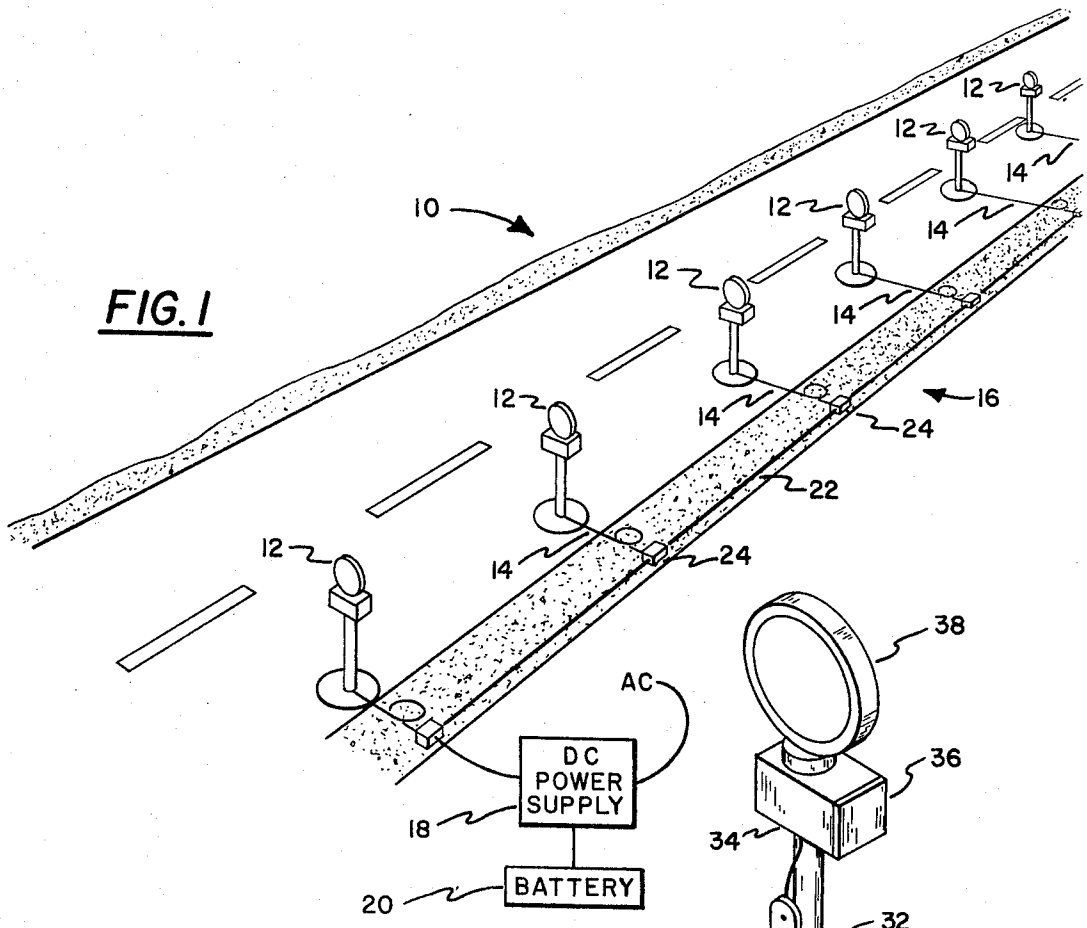


FIG. 1

FIG. 2

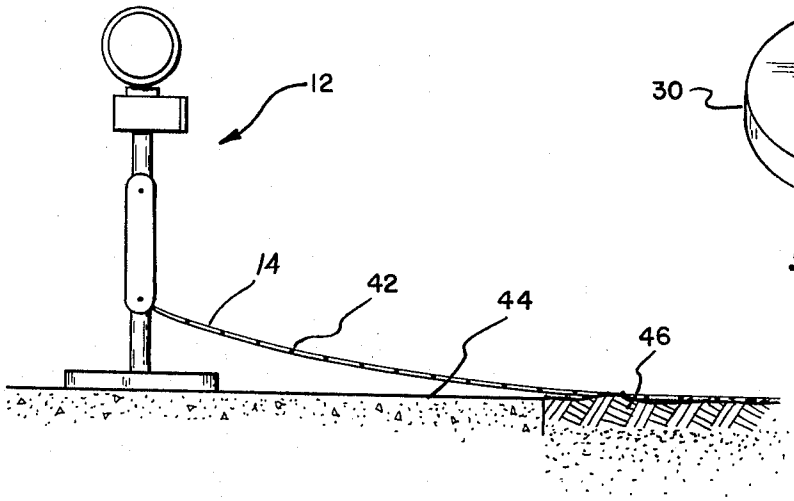


FIG. 3

FIG. 4

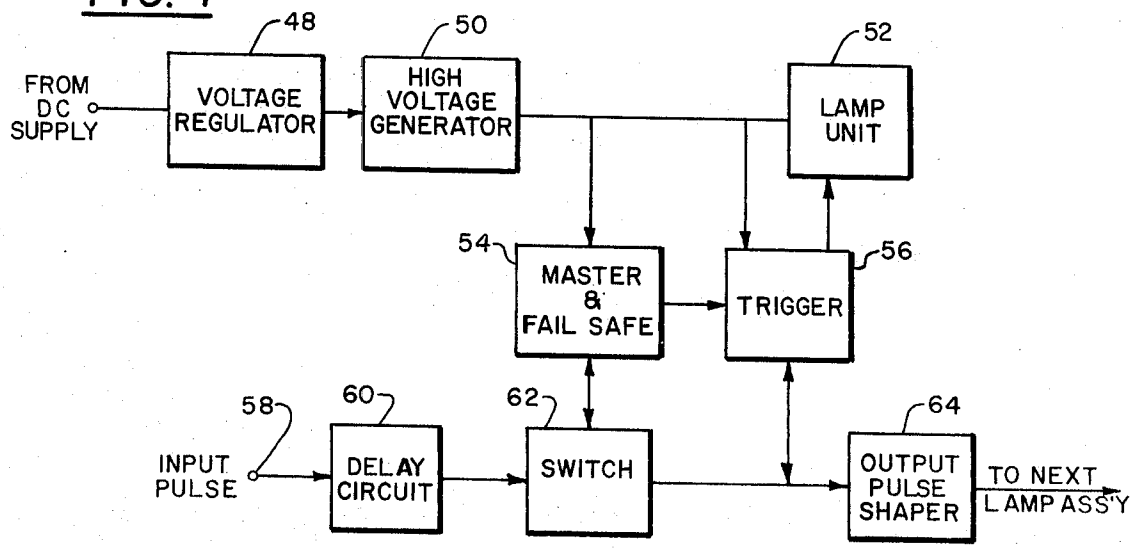
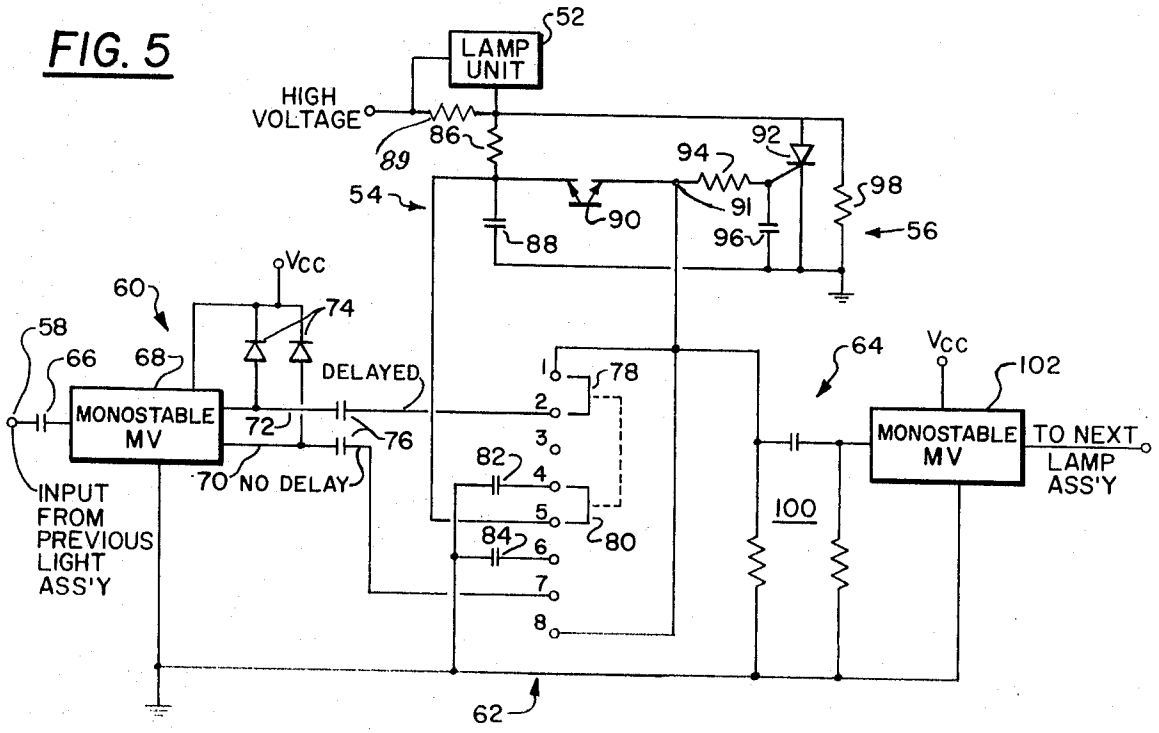

48
50
52
FROM DC SUPPLY
VOLTAGE REGULATOR
HIGH VOLTAGE GENERATOR
LAMP UNIT
54
MASTER & FAIL SAFE
TRIGGER
56
58
60
62
64
INPUT PULSE
DELAY CIRCUIT
SWITCH
OUTPUT PULSE SHAPER
TO NEXT LAMP ASS'Y

FIG. 5


52
LAMP UNIT
HIGH VOLTAGE
86
89
92
94
98
54
90
91
88
96
56
Vcc
60
74
58
66
68
DELAYED
78
64
Vcc
102
MONOSTABLE MV
72
76
82
TO NEXT LAMP ASS'Y
70
NO DELAY
100
INPUT FROM PREVIOUS LIGHT ASS'Y
84
80
62

STROBE LIGHT SYSTEM FOR TRANSITIONAL GUIDANCE AND DELINEATION

BACKGROUND OF THE INVENTION

This invention relates to strobe light delineation systems and more particularly to a strobe light system for vehicular transitional guidance.

Various approaches have been utilized to provide transitional guidance to motorists around obstacles on the road such as construction, accidents, etc. Such approaches have included barricades, series of barricades progressively positioned further onto a traffic lane, individual flashing lights, flashing lights in the form or arrows, signs, and various combinations of the above. These systems, however, are not entirely satisfactory because they primarily only warn the motorist of obstacles ahead rather than actually guide him into another lane around the obstacle. While some guidance is given by signs and progressively positioned barricades, the placement of such devices is awkward and time consuming, and visibility may be impaired by poor weather conditions, darkness, or poor placement of them. In summary, these systems do not provide clearly defined, easily visible guidance to the motorist especially on high speed roadways.

Strobe light systems per se have been utilized for aircraft landing guidance. One example of such a system is disclosed in the Zychal U.S. Pat. No. 3,519,984, which is owned by the assignee of the present invention. While Zychal was a substantial improvement over the prior art at the time, it was primarily designed for use as a portable landing light system, and therefore, would require modification for use on roadways. In addition, it has several disadvantages such as the reliance of each light assembly on the flashing of its immediately preceding light assembly to cause it to flash, and the lack of fail safe protection.

SUMMARY OF THE INVENTION

The present invention overcomes the disadvantages of the prior art by providing a novel strobe light system which gives early, clearly defined guidance to the motorist, may be easily and quickly installed, and includes provisions to allow accurate positioning quickly and simply. This is accomplished by providing a plurality of strobe light assemblies, detachably connected to a primary cable to which a power source is connected. Each strobe light assembly includes a portable support stand on which is mounted a circuit housing, a lamp unit, and a jumper cable for connection to the primary cable. Each jumper cable includes calibration markings so that the stands can be accurately positioned relative to the road to provide accurate positioning for transitional guidance. Each assembly also includes electronic circuitry accessably mounted in the circuit housing for triggering the strobe lamp unit, providing master or slave operation and fail safe protection. The circuitry may be easily switched to master operation at either of two rates, or to slave operation for simultaneous or sequential flashing.

It is therefore a general object of the present invention to provide a strobe light system which overcomes and minimizes the disadvantages of the prior art.

It is a more specific object of the present invention to provide a strobe light system in which the sequential flashing of each light assembly does not depend on the flashing of previous lamp units.

It is another object of the present invention to provide a strobe light system which includes fail safe protection. It is still another object of the present invention to provide a strobe light system which is readily selectively-adjustable to various modes of operation.

It is a further object of the present invention to provide a strobe light system for vehicular transitional guidance which may be easily and quickly installed. It is still a further object of the present invention to provide a strobe light system for vehicular transitional guidance which is easily and readily accurately positioned on a roadway.

BRIEF DESCRIPTION OF THE DRAWINGS

These, as well as other objects of the present invention, will become apparent to those skilled in the art from a persual of the appended claims, and the following description when read in conjunction with the attached drawings in which:

FIG. **1** is an illustration of the preferred embodiment of the invention as used on a roadway;

FIG. **2** is a perspective view of a lamp assembly therefor;

FIG. **3** is a simplified illustration, partially in section, illustrating the use of the calibrated markings on the jumper cable;

FIG. **4** is a block diagram of the electronic circuitry in each light assembly; and,

FIG. **5** is a schematic diagram of a portion of the circuitry shown in FIG. **4.**

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1–3** a preferred embodiment of a strobe light system of the present invention, generally designated **10,** includes a plurality of lamp assemblies **12** which are connected through individual jumper cables **14** to a primary cable **16** which in turn is connected to a DC power supply **18.** The DC power supply **18** may be of any conventional type for converting AC power derived from an available source, such as overhead wires, and/or a bank of batteries **20** which may be connected to supply power in case of failure of the AC source. The primary cable **16** may be made up of individual sections of cable **22** having connectors or junction boxes **24** to allow connection to the next section of cable, and also to receive a connector **26** at the free end of the jumper cables **14.**

Each of the light assemblies includes a portable support stand **28** having a base **30,** and a light support shaft **32;** a circuit housing **34,** having an openable lid **36** mounted on top of the support shaft **32;** and a lamp unit **38** electrically connected to circuitry mounted in the circuit housing **34.** The lamp unit may be any conventional strobe light such as a xenon flash tube available under various designations such as governmental designation STU**5.**

Each light assembly **12** also includes the jumper cable **14** which is connected at one end to the circuit housing **34** for electrical connection to a circuit therein, and may be coiled around an outwardly extending member **40** mounted axially along the support shaft **32.**

In order that the flashing lamps be clearly visible to oncoming traffic, it is important that they be accurately positioned so that an uninterrupted moving point of light, when the units are operating in sequence or a

flashing line when the units are operating simultaneously, be clearly visible to oncoming traffic.

In the present invention such accurate positioning is accomplished by calibration markings **42** provided on the jumper cable **14.** For accurate placement the markings **42** are successively aligned with the road edge or lane edge. That is, the first marking **42** of the first light assembly **12** is aligned with the edge, the second marking **42** of the second light assembly **12** is aligned with the edge, etc. The markings are spaced so that with the full system set up the last light assembly is at the other edge of the lane from which traffic is being guided. For example in FIG. **3,** the eleventh calibration marking is aligned with the edge between a right lane **44** and a road berm **46,** inasmuch as the right lane is to be freed of traffic as shown in FIG. **1.**

By virtue of the calibration markings on the jumper cables **14,** the line of light assemblies **12,** created when the system is set up, accurately follows the curvature of the roadway, thereby creating highly visible vehicular guidance. The novel physical structure of the present invention, described above, provides a number of advantages in addition to the accurate positioning of the light assemblies **12** already discussed. First, the system is quickly and easily deployable by merely reeling out the primary cable **16,** setting individual light assemblies **12** adjacent to the junction boxes **24,** connecting the primary cable **16** to the DC power supply **18,** connecting the individual light assemblies **12** to their respective junction boxes **24,** and accurately positioning the light assemblies **12** on the roadway as discussed previously. Furthermore, the entire system can be set up and operating on the side of the road before moving it onto the roadway, thereby allowing the guidance to be gradually imposed on traffic, and providing maximum safety for the set-up crew.

In addition, the fact that each light assembly **12** is identical except for perhaps the first assembly, which will typically be operated in master mode, eliminates any requirement for putting particular assemblies at specific locations. Finally, the accessible nature of the circuitry and the mode switch, discussed in detail hereinafter, allows the mode of operation to be easily changed, and also permits easy servicing or repairs of the circuitry.

In the present invention each light assembly **12** may be operated as a master in which it flashes at a preset rate independently of other light assemblies, or as a slave in which it flashes in response to an input pulse received from the preceding light assembly R. In the preferred embodiment a choice of two flash rates is provided for master operation, and a choice of either sequential or simultaneous operation is provided in the slave operation. Typically the light assembly closest to oncoming traffic will be operated as a master with the remaining light assemblies in the slave mode either simultaneously or sequentially. If operated sequentially, a point of light will appear to move down the lane guiding traffic to the next lane. If operated simultaneously, a full line of light will appear to flash on and off at the same time. If, however, the first assembly were inoperable to provide a master signal, it could be switched with any of the other assemblies inasmuch as they are all interchangeable. The only change that would be required would be to manually alter the switch position within the circuit housing **34.**

The novel circuitry mounted in the circuit housing **34** of each light assembly **12** provides the various modes operation, and permits the easy selection of the desired mode. The circuitry also includes fail safe protection so that if the assembly is switched to the slave mode, but no external pulses are received, a fail safe pulse is provided to flash the lamp. One embodiment of circuitry suitable for these purposes is illustrated in block diagram in FIG. **4.**

Referring to FIG. **4,** a voltage is fed from the DC supply **18** to a voltage regulator **48,** which may be for example a Fairchild UA7812. The output of the voltage regulator **48** is fed directly or through a voltage divider and a zener diode combination, not shown, (if required to produce the necessary voltage level) to supply a low voltage for operating integrated circuitry to be discussed later. The output of the voltage regulator **48** is also fed to a high voltage generator **50** which may be a conventional blocking oscillator with a step-up transformer. The output of the high voltage generator is supplied to a lamp unit **52** and to a master and fail safe unit **54** and a trigger **56** which will be discussed in greater detail hereinafter with respect to FIG. **5.** The high voltage generator typically has an output voltage on the order of 350–400 volts, the level necessary to energize the lamp unit **52.** The system also includes an input pulse terminal **58** for receiving a pulse from a preceding light assembly which is connected to supply received pulses to a delay circuit **60,** the output of which is supplied to a switch **62.**

The switch **62,** as will be discussed in detail hereinafter, is connected to the master-fail safe unit **54,** and the trigger **56** to determine the mode of operation. The output from the switch that is supplied to the trigger **56** is also supplied to an output pulse shaper **64,** which provides an output pulse to the next light assembly. The output pulse shaper **64** is also connected to the trigger **56** so that it will receive an input signal if the circuitry is operating in its master mode.

In operation the DC voltage supplied from the DC supply **18** is regulated by the voltage regulator **48,** and is stepped-up by the high voltage generator **50** to supply the lamp unit **52,** as well as the master and fail safe **54** and the trigger circuit **56** with operating voltage. The regulated voltage may be stepped down, if required, to supply the proper bias voltage to semiconductor components in the circuitry.

As is conventional the lamp unit **52** includes a capacitor connected to a trigger electrode, which is rapidly discharged to flash the lamp. This capacitor is connected to the trigger **54** which will discharge it in response to a pulse from either the input terminal **58** and delay circuit **60** or the master and fail safe **54,** depending on the state of switch **62** or the occurrence of a defect requiring the operation of the fail safe. The position of the switch **62** determines the mode of operation of the light assembly, as discussed in detail hereinafter, through its connection to the master and fail safe **54** and the trigger **56.**

The output pulse of the switch **62** which is supplied to the trigger when the switch **62** is in its slave position is shaped in the output pulse shaper **64** for feeding to the input pulse terminal **58** of the next succeeding light assembly. If the switch **62** is in its master position, an output pulse from the trigger **56** will be applied to the output pulse shaper **64** for the same purpose. It should be appreciated that in either slave or master mode, the

output pulse to be fed to the next light assembly is not dependent on the flashing of the lamp itself. Therefore, any defect or lamp failure will not affect the operation of subsequent light assemblies.

Inasmuch as the voltage regulator **48,** high voltage generator **50,** and lamp unit **52** are conventional and/or commercially available items they will not be discussed in further detail. The remainder of the block diagram is shown schematically in FIG. **5.**

Referring to FIG. **5,** an input pulse from a previous light assembly is fed from the input pulse terminal **58** through a coupling capacitor **66** to the delay circuit **60.** The delay circuit **60** includes a monostable multivibrator **68** which may be a SN54121 available from Texas Instrument. The monostable multivibrator **68** is supplied with supply voltage VCC from the voltage regulator **48,** and is suitably biased and timed. The monostable multivibrator **68** has two outputs, namely a nondelayed signal output line **70,** and a delayed signal output line **72.** A pair of diodes **74** are, respectively, connected between each of them, and the supply voltage *Vcc* to provide noise supression. Output pulses on each of the lines **70** and **72** are fed through coupling capacitors **76** to the switch **62.**

The switch **62** includes eight terminals numbered **1** through **8** in FIG. **5,** which are selectively interconnected by two sliding contacts **78** and **80,** which are tied together to slide simultaneously. The delayed pulse line **72** is connected to terminal **2,** and the nondelayed pulse line **70** is connected to terminal **7.** Terminals **1** and **8** are both connected to the trigger **56,** and also to the output pulse shaper **64.** Terminal **3** is an open terminal, and terminals **4** and **6** are individually connected through capacitors **82** and **84,** respectively, to ground. Terminal **5** is connected to the master **54.**

The master and fail safe **54** includes an oscillator circuit which comprises a timing resistor **86** connected at one end to the high voltage supply and at the other end to one end of a timing capacitor **88,** the other end of which is connected to ground. A diac or trigger diode is connected to the junction between the resistor **86** and the capacitor **88.** The other end of the diac **90** is connected to the input point **91** of the trigger **56,** to which the terminals **1** and **8** of the switch **62,** as well as the output pulse shaper **64,** are also connected. The trigger **56** consists of an SCR **92** having its anode connected to the high voltage supply and the discharge capacitor of the lamp unit **52** and its cathode connected to ground. The gate electrode is connected through a resistor **94** to the input point **91,** and a capacitor **96** to ground, a resistor **98** is also connected across the SCR.

The output pulse shaper includes a filter circuit **100** comprising a suitable resistor-capacitor network, and a monostable multivibrator **102** which may be a SN54121 available from Texas Instrument. The monostable multivibrator **102** is suitably biased and tuned, and connected to bias voltage Vcc.

In operation, as discussed previously, the lamp unit **52** will be flashed when the capacitor included in the unit is rapidly discharged. This occurs when the normally off SCR **92** is turned on in response to a pulse at the trigger point **91,** which applies a voltage to its gate electrode. This pulse will be fed through either the switching terminals **1** or **8,** or the master or fail safe **54.**

The master and fail safe **54** merely operate as an oscillator to supply pulses to the trigger input point **91.** That is, the timing capacitor **88** charges up through the timing resistor **86** until the diac **90** is turned on. If operating as a master, pulses will be supplied at a pulse rate depending on the value of the timing capacitor **88** alone for the fast rate master, or by the value of the timing capacitor **88** together with the capacitor **84** connected to the switch terminal **6** for the slow rate master. If operating as a fail safe, when the switch is in the slave mode, the pulse rate is determined by the valve of the timing capacitor **88** and the capacitor **82** connected to the switch terminal **5.** However, in fail safe pulses will not be provided as long as the system functions properly, inasmuch as the much faster rate of pulses fed to input terminal **58** will trigger the SCR **92** on thereby continuously discharging the capacitors **88** and **82** before they reach the level necessary to turn on diac **90.**

For master operation at the slow pulse rate the switch is set with the sliding contacts **78** and **80** connecting terminals **2** and **3** and terminals **5** and **6** respectively. With the switch **62** in this position neither delayed pulses on the line **72** nor the nondelayed pulses on the line **70** are supplied to the trigger input point **91.** Rather the capacitor **84** is connected in parallel with the timing capacitor **88,** as discussed previously. If the faster rate master mode is desired, the switch **62** is positioned with the contact **78** connecting terminals **3** and **4,** and the contact **80** connecting terminals **6** and **7.** In this mode there is no additional capacitor across the timing capacitor **88,** and therefore the master can oscillate at a faster pulse rate.

For sequential slave operation, the contacts **78** and **80** are positioned to connect terminals **1** and **2,** and terminals **4** and **5** respectively. In this position delayed pulses on the line **72** are coupled to the trigger junction, and to the output pulse shaper **64.** The pulse rate of this mode is solely dependent on the timing of the monostable multivibrator **68.** Also in this position the capacitor **82** is connected in parallel with the timing capacitor **88** to provide the oscillator with a potential pulse rate much slower than the delayed pulse rate. This arrangement provides the fail safe protection. For simultaneous slave operation, the contacts **78** and **80** are positioned to connect terminals **4** and **5,** and terminals **7** and **8** respectively. In this position the master and fail safe **54** is again set for fail safe, and nondelayed pulses on the line **70** are applied to the trigger input point **91.**

Thus, a unique and novel strobe light system has been disclosed. While the detailed description has been directed primarily to the use of the system for transitional guidance, it will be apparent that the system could readily be utilized for other purposes as well. For example, it could be permanently installed for road delineation and energized in response to a sensed condition such as fog, snow, etc. Such a use would only require the connection of a suitable sensing device between the source of power and the DC power supply so that the system would be energized only when the condition is sensed.

The novel physical structure which is primarily directed to the use of the system for vehicular transitional guidance provides a system which can be quickly, easily, and safely set up, and which can be easily accurately positioned. The novel circuitry provides a system

which is flexible, permitting the interchangeability of light assemblies and a variety of operating modes, and provides fail safe protection.

It is believed that the many advantages of the present invention will now be apparent to those skilled in the art. It will also be apparent that a number of variations and modifications may be made without departing from its spirit and scope. Accordingly the foregoing description is to be construed as illustrative rather than limiting.

What is claimed is:

1. A strobe light system for deployment along a roadway to provide vehicular transitional guidance comprising:

a plurality of light assemblies, each of said light assemblies including;

a portable support stand,

a strobe lamp unit mounted on said support stand,

a circuit housing mounted on said support stand,

a jumper cable connected at one end to said assembly, and

circuit means mounted in said circuit housing for controlling the flashing of said strobe lamp unit said circuit means including trigger means for causing said strobe lamp unit to flash,

input means for receiving an external pulse from the circuit means of a preceding light assembly,

output means connected to said trigger means for supplying an external pulse to the circuit means of the succeeding light assembly whenever said trigger means receives an actuating pulse,

switching means for selectively connecting said input means to said trigger means, so that said external pulse actuates said trigger means, and

pulse generator means connected to said trigger means for providing an actuating pulse to said trigger means,

said switching means including means for controlling said pulse generator means to operate as a master trigger actuating pulse generator when said switching means causes said input means to be disconnected from said trigger means, and fail safe means for controlling said pulse generator means to operate as a fail safe trigger actuating pulse generator when said switching means causes said input means to be connected to said trigger means; and

a primary cable which supplies operating voltage to and interconnects said circuit means of said light assemblies through the individual jumper cable associated with each of said light assemblies.

2. The system of claim **1** wherein each of said jumper cables includes calibrated markings thereon to facilitate accurate positioning of the light assemblies.

3. The system of claim **1** wherein said primary cable includes a plurality of connectors spaced along its length,

wherein each of said jumper cables includes connector means at its other end for connection to any one of said connectors, and

wherein said circuit housing is operable to provide easy access to said circuit means.

4. A control circuit for operating each one of a plurality of strobe lights interconnected to form a system in which the flashing thereof will occur in a desired manner comprising:

trigger means for causing a strobe light to flash,

input means for receiving an external pulse from the control circuit of the preceding strobe light,

output means connected to said trigger means for supplying an external pulse to the control circuit of the succeeding strobe light whenever said trigger means receives an actuating pulse,

switching means for selectively connecting said input means to said trigger means so that external pulses received by said input means may actuate said trigger means, and

pulse generator means connected to said trigger means for providing an actuating pulse to said trigger means,

said switching means including means for controlling said pulse generator means to operate as a master trigger actuating pulse generator when said switching means is in a mode causing said input means to be disconnected from said trigger means, and fail safe means for controlling said pulse generator means to operate as a fail safe trigger actuating pulse generator when said switching means is in a mode causing said input means to be connected to said trigger means.

5. The circuit of claim **4** wherein said pulse generator means includes a timing capacitor for determining the pulse rate thereof said timing capacitor being discharged whenever said trigger is actuated, and

wherein said fail safe means comprises a capacitor which is selectively connected in parallel with said timing capacitor to reduce the pulse rate of said pulse generator means below the pulse rate of said external pulses when said switching means is operated to connect said input means to said trigger means.

6. The circuit of claim **4** wherein said input means includes delaying means for delaying a received external pulse so as to actuate said trigger means after a time delay, when said input means is selectively connected through said switching means to create sequential flashing of the strobe lights of the system.

7. The circuit of claim **6** wherein said input means further includes means for supplying a received external pulse to actuate said trigger means without a time delay, so as to create simultaneous flashing of the strobe lights of the system, and wherein said switching means may selectively connect either said delayed external pulse or said nondelayed external pulse or neither of said pulses to said trigger means.

* * * * *