

[54] NAVIGATIONAL LIGHT SYSTEM

[75] Inventor: Thomas A. Jacobs, Houston, Tex.

[73] Assignee: Tideland Signal Corporation,
Houston, Tex.

[22] Filed: Jan. 4, 1973

[21] Appl. No.: 320,982

Related U.S. Application Data

[62] Division of Ser. No. 211,605, Dec. 23, 1971, Pat. No. 3,781,853.

[52] U.S. Cl. 340/251, 315/89

[51] Int. Cl. H05b 39/10

[58] Field of Search 340/251, 29;
315/88-93; 240/37.1

[56] References Cited

UNITED STATES PATENTS

2,258,575	10/1941	MacKay	240/37.1
2,342,085	2/1944	MacKay	240/37.1
2,465,795	3/1949	Foulds	315/89
3,577,135	5/1971	Steen	315/93

Primary Examiner—John W. Caldwell

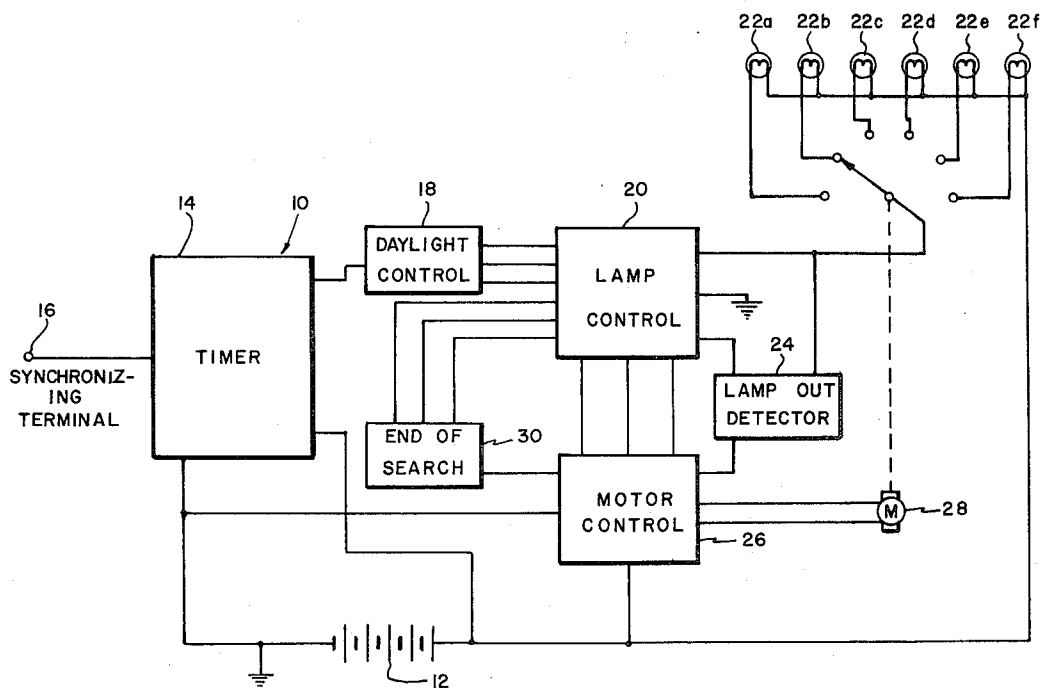
Assistant Examiner—Daniel Myer

Attorney, Agent, or Firm—Jefferson D. Giller; James
F. Weiler; William A. Stout

[57] ABSTRACT

A flashing light timer for a navigational light having provision to send, receive and utilize a synchronizing signal in which a plurality of lights have their timers connected together so as to flash simultaneously, but will still operate in the event any one of the navigational lights fail. A coded timer for controlling the flashing code of a navigational light having a plurality of time constant circuits connected to a counter for readily changing the flashing code of a light. A navigational light having a logical circuit for sensing a burned out lamp without requiring a resistive element. A lamp changing circuit that allows the new lamp to be placed accurately into operative position. And a circuit for switching off power from the navigational light during the lamp changing process for preventing sparking of the electrical contacts.

4 Claims, 8 Drawing Figures



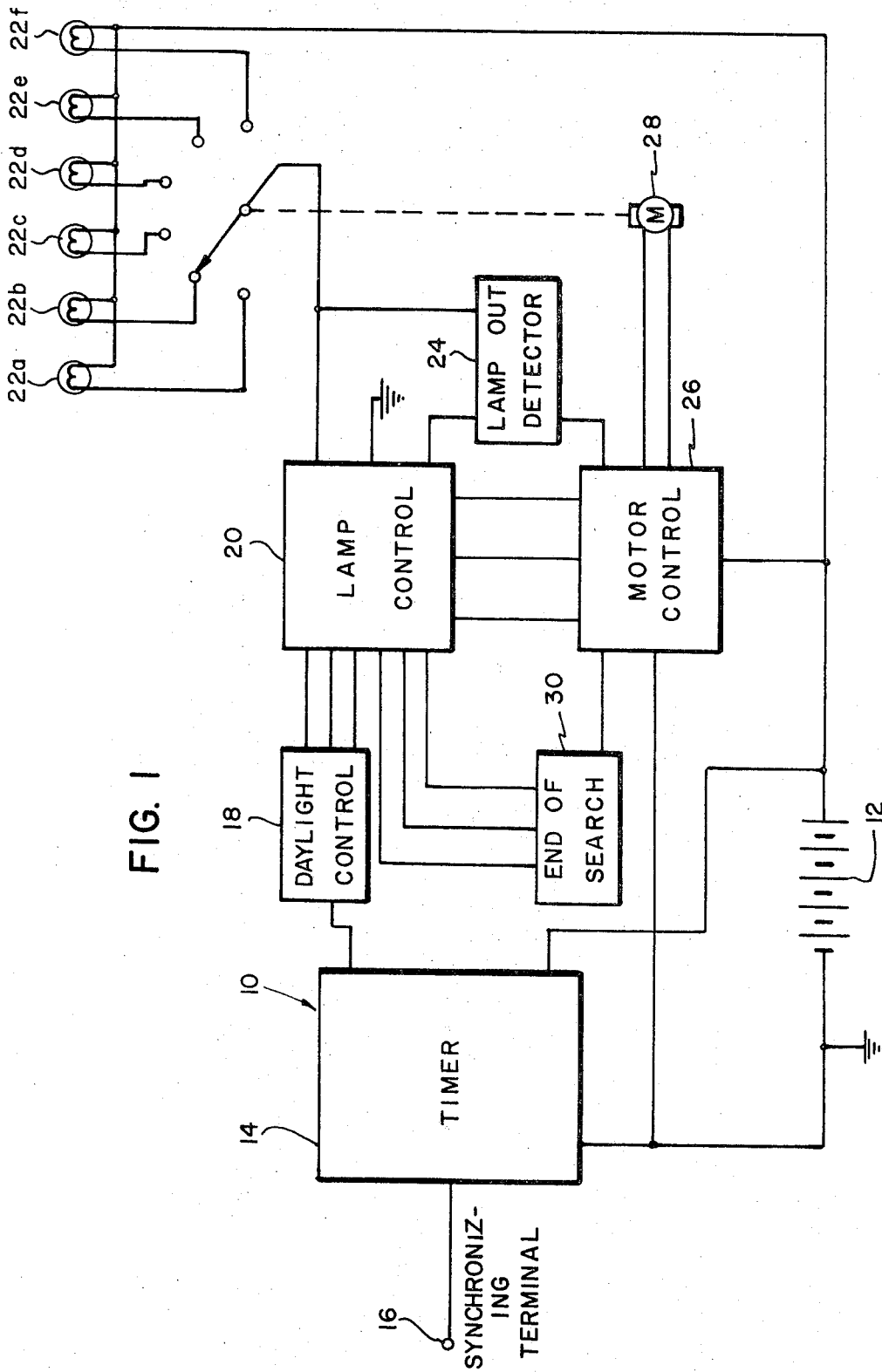


FIG. 2

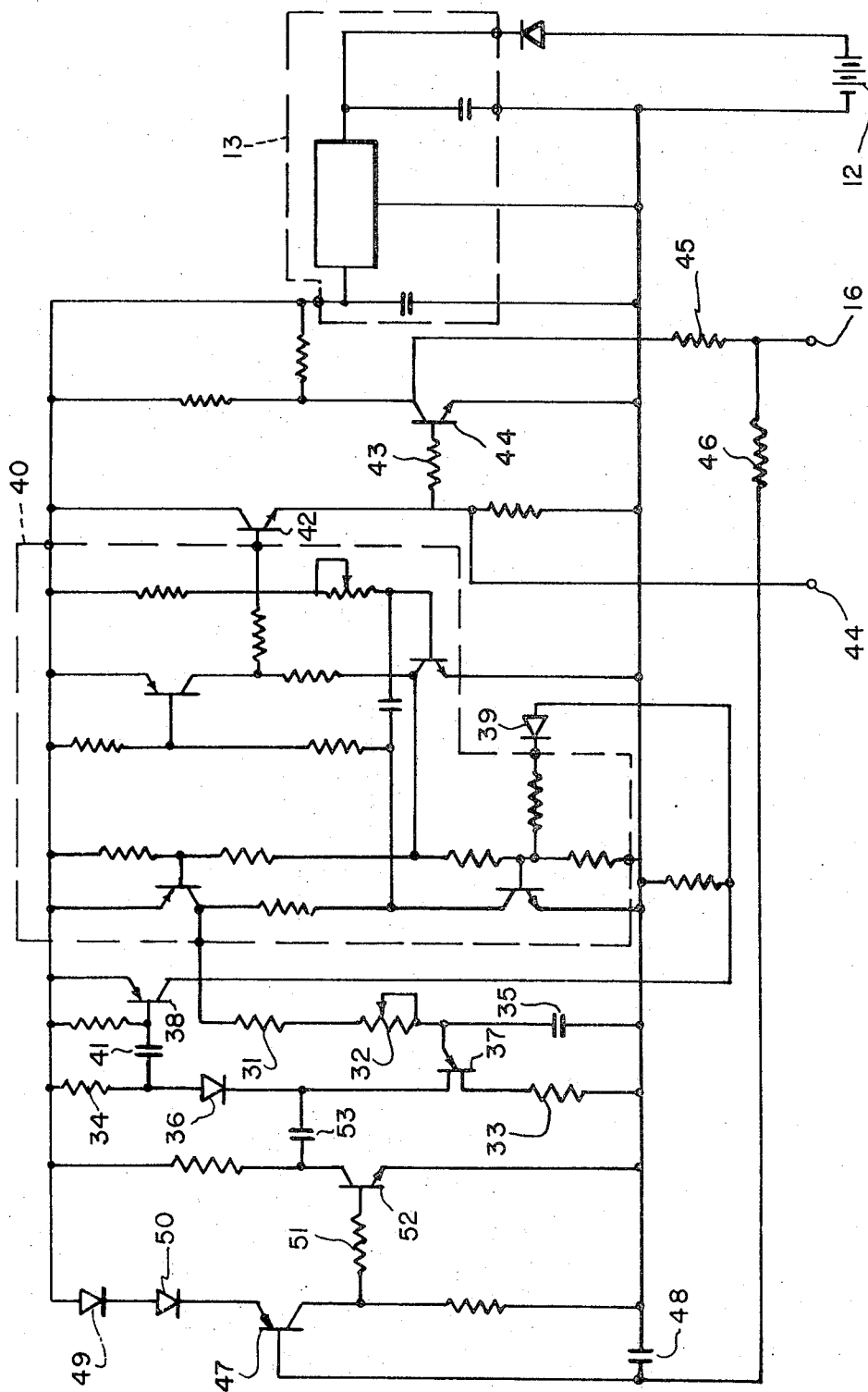


FIG. 3

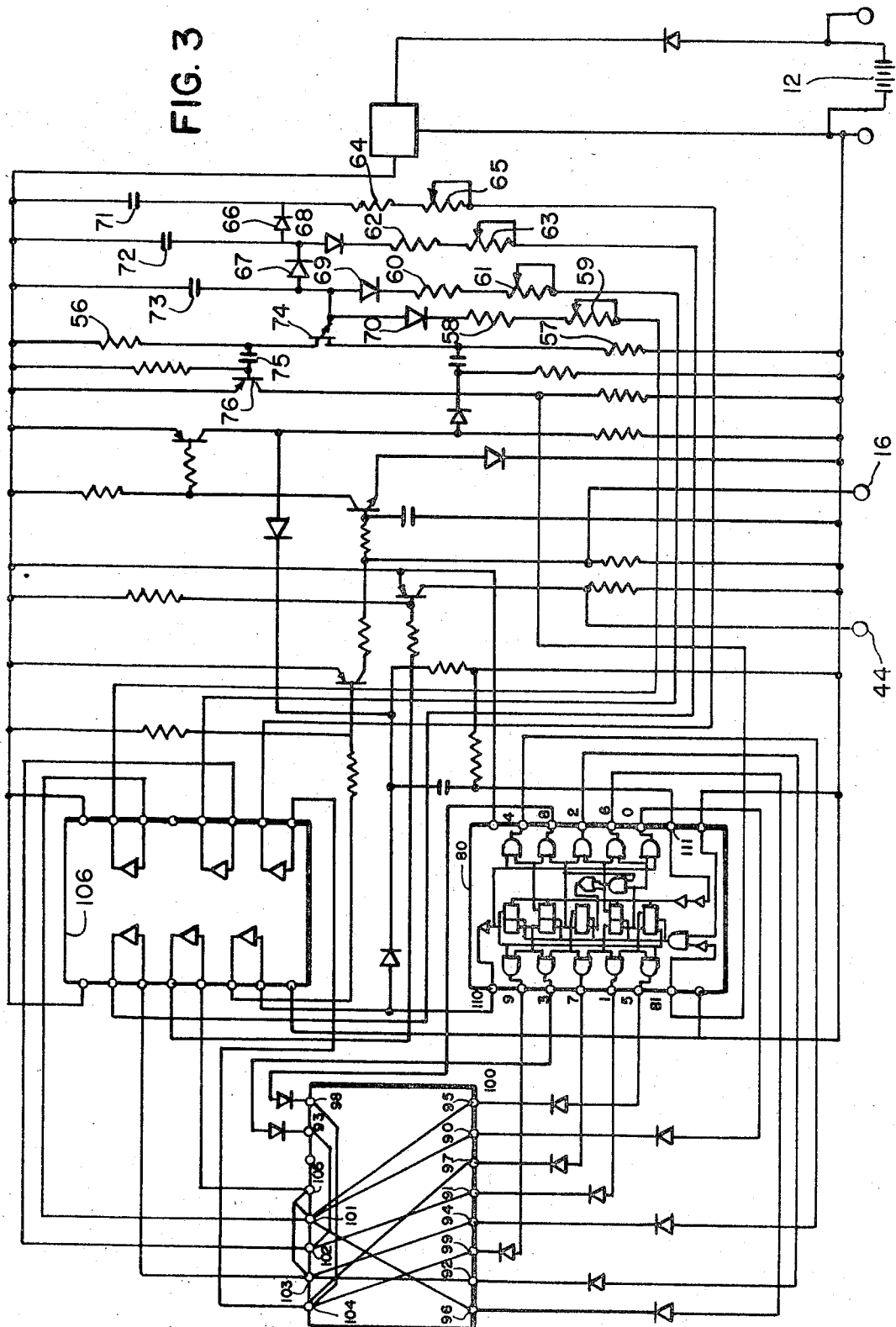
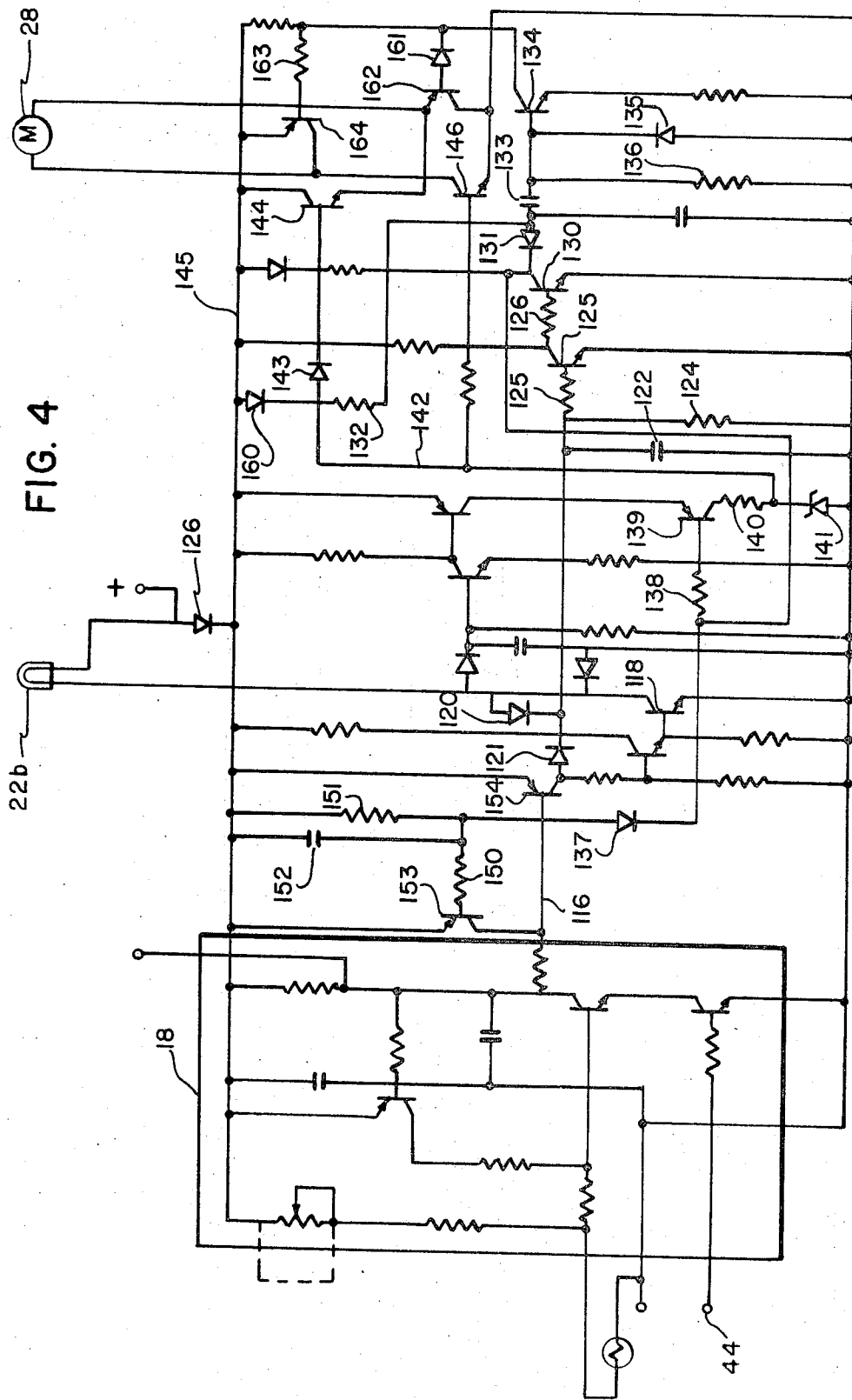
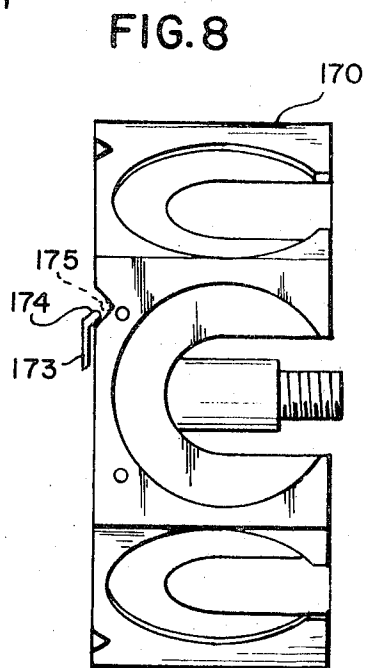
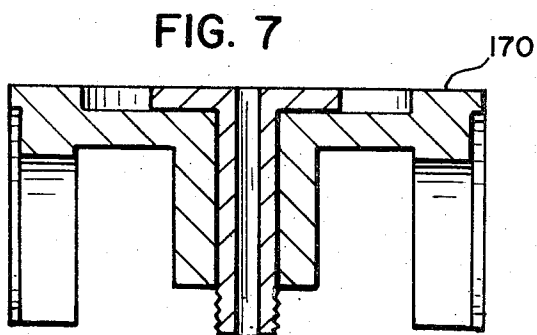
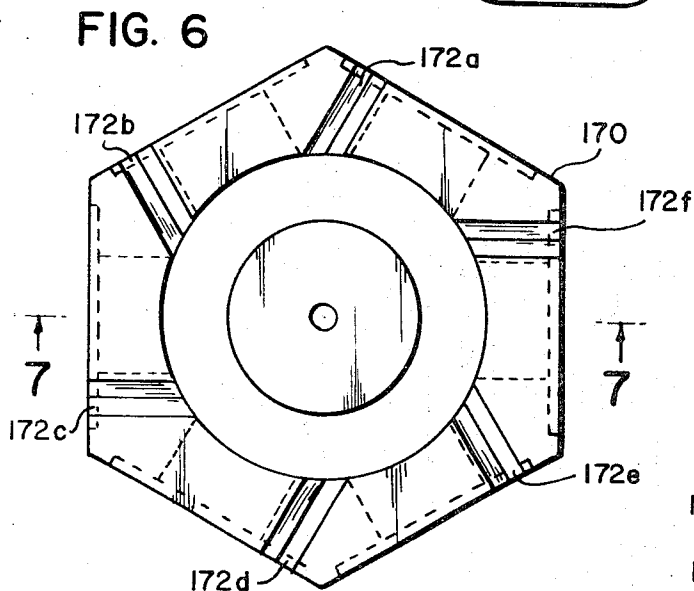
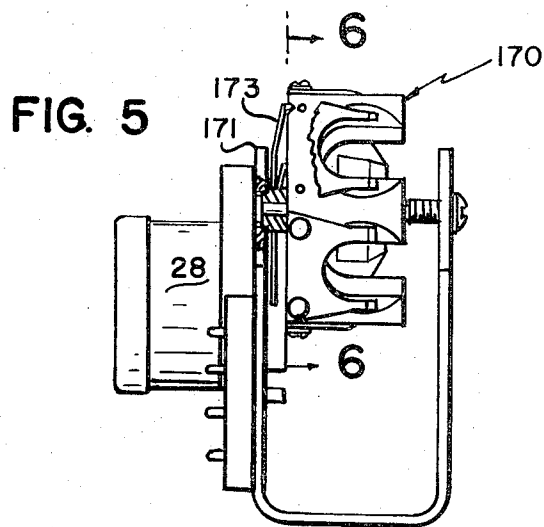


FIG. 4





NAVIGATIONAL LIGHT SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a division of application Ser. No. 211,605, filed Dec. 23, 1971, now U.S. Pat. No. 3,781,853, issued Dec. 25, 1973.

BACKGROUND OF THE INVENTION

It has been conventional to flash in synchronism multi-light installations for navigational lights, such as lights for marking buoys, channels and obstructions, using the so-called master-slave system. In this system only the master light contains a timer and an automatic sun switch and the power switch that turns the master light and all of the slave lights off and on. In the event the total current required by the slave lights is more than the power switch of the master light can handle, a third type of light, the slave repeater, is required. The slave and slave repeater lights have no automatic sun switch or timer and only the repeater has a power switch to take some of the current load from the master. Failure of the master light means failure of all of the lights of the navigational system and three different types of lights may be required for a multi-light installation. Also in the past, timers were designed to flash complex codes, that is a characteristic consisting of more than just an on-off flash as a Morse code letter, using a series of flip-flops to achieve the proper code such as U.S. Pat. No. 3,027,491. For example in a light flash characteristic equivalent to dot, dot, dash, the two dots would be the basic time, and also the dash time must be a multiple of the dot time. There is no way to adjust the individual times separately and the flip-flop timer approach offers very little versatility. Additionally, once a timer has been designed to flash one code sequence, it cannot realistically be made to flash another and thus the flip-flop method required that a timer be designed for each different characteristic.

It has also been standard practice to sense a burned out lamp condition by monitoring the current through the lamp. One method requires the use of a resistive device in series with the light. Such a device requires power which could be used by the light which was disadvantageous, particularly in navigational lights which commonly use battery power.

It is further conventional in lamp changing systems to rotate a turret containing a plurality of spare lamps such as shown in U.S. Pat. No. 3,308,358, but no provision is made to insure that the turret motor stops in the same place every time which is important in a precision optical navigational lantern. Furthermore, the rotation of a turret may produce electrical sparking at the electrical contacts which is undesirable, particularly in hazardous electrical locations.

The present invention is directed to an improved navigational light system which overcomes the difficulties of the prior art.

SUMMARY

One feature of the present invention is the provision of a plurality of navigational lights each including a separate flashing timer in which the timer of each light is connected to the input of the flashing timer of all of the lights whereby all of the timers are actuated when one of the timers is first actuated thereby synchronizing all of the navigational lights, but insuring that in the event

one of the lights fails that the remainder will operate and will operate in synchronism.

Another feature of the present invention is the provision of a navigational light having a versatile timer which has the capability to time a light to flash any code, such as a letter or any number from one to ten of the international Morse code. The present timer utilizes a plurality of different time constant circuits connected to the timer, and a counter having a plurality of sequentially actuated outputs. The outputs of the counter are connected to selected of the time constant circuits through a code board to provide the desired flashing code and can be easily varied to change the code if desired.

Another object of the present invention is to provide a circuit for sensing a burned out lamp without using a power consuming resistive element in series with the lamp.

Still a further object of the present invention is the provision of a lamp changing circuit in which the motor is actuated by a reverse pulse after a new lamp is rotated into position to allow the turret to be accurately aligned so that the new lamp will be in a proper position in line with the optic of the lantern.

Yet a still further object of the present invention is the provision of switching off power from the electrical lamp contacts during the lamp changing process in order to enable the lamp to be non-sparking so as to be used in hazardous electrical locations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram in schematic of a single navigational light of the present invention,

FIG. 2 is an electrical schematic of one type of timer that may be used to provide a standard on-off flash characteristic and may be synchronized with other lights in an installation,

FIG. 3 is an electrical schematic of a timer that may be used to flash a light in various combinations of short and long flashes,

FIG. 4 is an electrical schematic of a lamp-out sensing circuit and lamp changing circuit,

FIG. 5 is an elevational view, partly in cross section of a lamp changing turret,

FIG. 6 is a cross-sectional view taken along the line 6—6 of FIG. 5,

FIG. 7 is a cross-sectional view taken along the line 7—7 of FIG. 6, and

FIG. 8 is an enlarged cross-sectional view of the turret and power brush illustrating the alignment of the turret after changing a lamp.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, a single navigational light is shown generally referred to by the reference numeral 10. The light 10 generally includes a power source such as a battery 12, a timer 14 which is continuously cycling and which includes a synchronizing terminal 16, which will be more fully described hereinafter, a suitable sun switch or daylight control circuit 18, which may be of any suitable type, such as shown in U.S. Pat. No. 3,492,529. If the ambient light level is above a pre-set level, the timer signal is stopped by the daylight control unit 18. If the ambient light is below a desired level, the timer signal is coupled to a lamp control circuit 20 to provide voltage and current amplification of the

timer signal to one of a plurality of lamps 22a-22f, one of which is in the operative position in a lamp lens, here shown as number 22b. A lamp-out detector circuit 24 determines when the lamp in the operative position is burned out and in that event actuates a motor control circuit 26 to drive a motor 28 to turn a lamp turret to move one of the spare lamps into the operative position. Actuation of the motor control circuit interrupts the timer signal and also energizes the end of search circuit 30 and in the event all of the lamps 22a-22f are burned out and the motor control circuit 26 is not turned off, the end of search circuit 30 will run out and turn off the power circuit to save power of the battery 12.

One of the features of the present invention is the provision in a navigational light system having a plurality of navigational lights 10 each of which includes a timer 14 and in which each of the outputs of all of the timers 14 are connected to the synchronizing terminal 16 of all of the timers 14 whereby the timers 14 of all of the navigational lights 10 will be synchronized in order that all of the lights 10 will flash at the same time. That is, the timer 14 will function normally to start its own sequence to originate a synchronizing pulse but if a synchronizing signal appears on the synchronizing terminal 16 before the timer 14 is ready to create its own "on" signal, the synchronizing signal will initiate all of the timers 14. Thus the timers 14 will follow the leader.

Referring now to FIG. 2, the timer 14 may be a standard unijunction timer consisting of resistors 31, 32, 33 and 34; capacitor 35; diode 36; and unijunction transistor 37. The pulse output of the unijunction timer is amplified by transistors 38 and coupled through diode 39 to a conventional monostable multivibrator 40, as is conventional. When the multivibrator 40 is in the stable state, voltage from the battery 10 and regulator and filter 13 is present at the top of resistor 31. Capacitor 35 then charges up through resistor 31 and variable resistor 32. This charge time corresponds to the off time. Unijunction 37 fires and a negative pulse is generated between resistor 34 and diode 36. This pulse is coupled by capacitor 41 to transistor 38 where the pulse is inverted and amplified. The pulse (now positive) is coupled through diode 39 to monostable multivibrator 40 which is now triggered to the astable state. In the astable state there is no voltage on resistor 31 so the timer is inactive. At the same time, the output of the astable state of the multivibrator 40 which is connected to the base of transistor 42 is high. This high at the base and emitter of transistor 42 is the on time pulse for the lamp timer and is connected to the lamp control circuit 20 through terminal 44. At the end of the time constant of the astable state, the multivibrator 40 flops back to the stable state, the signal to transistor 42 goes to zero and the cycle is repeated.

It is also noted from FIG. 2, that the timer signal on the emitter of transistor 42 is coupled through resistor 43 to transistor 44. At the collector of transistor 44 the signal is inverted and amplified, and coupled through resistor 45 to the synchronizing terminal 16. It can be seen now that the synchronizing terminal 16 is high during the off time and low during the on time. Further from FIG. 2, it can be seen that the signal at the synchronizing terminal 16 is coupled through resistor 46 to the base of transistor 47. Capacitor 48 and resistor 49 act as a filter to keep noise spikes from turning on

transistor 47. Diodes 49 and 50 are added to increase the required turn on signal and thus aid in noise immunity. The signal is then inverted on the collector of transistor 47 and coupled through resistor 51 to transistor 52 where it is amplified and inverted. Thus, the collector of transistor 52 is in phase with the signal on the synchronizing terminal 16. Therefore, when the timer is switched to the on state, the collector of transistor 52 changes from a "high" to a "low" of nearly zero voltage. The transition from high to low of the collector of transistor 52 causes a negative spike to be coupled through capacitor 53 to the unijunction timer between base two of the unijunction transistor 37 and diode 36. Because of this, the base two voltage of the unijunction transistor 37 is brought below the emitter voltage forcing the unijunction 37 to fire. If the timer 14 is being operated as a single unit, the negative spike through capacitor 53 has no effect since the unijunction 37 has already fired (it was the firing of the unijunction 37 that created this negative spike). However, when more than one timer 14 have their synchronizing terminals 16 connected together, the first timer 14 to flash causes a low to be seen at the common synchronizing terminal 16. This low results in the negative spike through capacitor 53 in the remaining timers 14 causing them to switch to the on position. The result of this is that all of the timers 14 connected together come on at the same time once the on time has been initiated by the first actuated timer 14. Once the on time has been initiated, each flasher follows its own on and off time constant until the first flasher turns on again. Then once again all of the flashers 14 will follow the leader and the cycle repeats itself again.

The timer shown in FIG. 2 gives a simple on and off flashing code. A more versatile and complex code may be provided by the timer of FIG. 3 which has the capability to time a light to flash in a variable code such as a letter or number from one to ten of the international Morse code and which can be easily and inexpensively adjusted to change to a different code. The unijunction timer of FIG. 3 consists of resistors 56 through 65; diodes 66 through 70; capacitors 71 through 73 and complementary unijunction transistor 74. A plurality of separate RC time constant paths, here shown as four, may be provided for the unijunction transistor 74. The diodes 66 through 70 isolate the four different RC time constant paths from each other. The first path, which may be used for a short time pulse, consists of resistors 58 and 59, diode 70 and capacitor 73. The second path, which may also be used for a short pulse, consists of resistors 60 and 61, diode 69 and capacitor 73. The third path which may be used for a longer time period or pulse, consists of resistors 62 and 63, diodes 67 and 68, and capacitors 72 and 73. The fourth time constant path which may be used for an even longer time period or pulse, consists of resistors 64 and 65, diodes 66 and 67, and capacitors 71, 72 and 73. The connection of these various time constant paths to an appropriate signal source will be described hereinafter. The output is taken from base one of the complementary unijunction 74 and is coupled through a capacitor 75 to a transistor 76. At the collector of transistor 76 the pulse from the unijunction 74 is amplified, inverted, and fed into the clock input terminal 81 of a decade counter, generally indicated by the reference numeral 80. The counter is a conventional counter such as RCA Model No. CD4017AE and produces ten distinct and separate se-

quential and separately timed output signals called out as counts 0 through 9. Upon receiving a pulse at the clock input 81, the output from the counter 80 shifts to the next numeral order count terminal in sequence. The terminal for the count being sampled is high while all other count terminals are low. The counts 0 through 9 from the counter 80 are diode coupled to terminals 90-99 on a code board 100.

The code board 100, in addition to the terminals 90-99 for the separate count outputs from the counter 80, has a signal out terminal 105 and four terminals that, after going through an amplifier board 106 connect to the four RC time constant paths previously described. Therefore, by properly interconnecting the wiring on the code board 100 between the count terminals 90-99, the time constant feedback terminals 101 through 104, and the output terminal 105 will determine the combination of long and short light pulses the timer will produce. As an example only, the connections will be described in which the navigational light is required to flash a Morse letter "P" in which the dots are half a second long, the dashes are two seconds long, the eclipses are one second long, and the duty cycle is twenty seconds. The letter P in Morse code is dot, dash, dash, dot which will be displayed as a half second on, 1 second off, 2 seconds on, 1 second off, 2 seconds on, 1 second off, half second on, and 12 seconds off. Also assume that the path one time constant path has been adjusted a half second long, path 2 to 1 second long, the time constant path 3 to 2 seconds long, and the time constant path 4 to 3 seconds long. Since the on light pulses will be through terminals 101 and 103 to the first and third time constant paths, a jumper connection will be provided between the signal out terminal 105 and the terminals 101 and 103. Since the code starts with a dot, which is a short time, count 0 from the counter 80 will be connected from terminal 90 to the terminal that is fed back to the one half second time constant path terminal 101. The next function is the 1 second eclipse so count 1 from the counter 80 is fed from terminal 91 on the code board 100 to terminal 102 to the one second time constant path. The next function to be performed is the two second dash which will be count 2 from the counter 80 through terminal 92 which must be connected to terminal 103 which is fed to the path three time constant of two seconds. Count 3 is another one second eclipse, so terminal 93 is connected to time constant path two or terminal 102. Count 4, another dash of two seconds duration, is obtained by connecting terminal 94 to path three or terminal 103. Count 5 obtains another one second eclipse by connecting terminal 95 to terminal 101. Count 6 is another half second dot and is obtained by connecting terminal 96 to terminal 101 to obtain a half second time constant path. Counts 7, 8 and 9 from the counter 80 may be used together to achieve the twelve second off time, therefore, these three counts may be obtained by connecting each of the terminals 97, 98 and 99 to the four second time constant path or terminal 104.

From the above description, it can be seen that various combinations of long and short times may be easily obtained merely by making the required connections on the code board 100 between the output terminals 90-99 from the counter 80 and the time constant feedback paths through terminals 101 through 104. Of course, a still more versatile and complex code can be provided by providing the timer with additional time

constant paths and a counter with greater number of outputs. However, the use of the decade count 80 with the decoder board 100 and the various time constant feedback paths provides a versatility and ease of operation not available in the conventional flip-flop type counters.

The synchronizing of the timer of FIG. 3 when a plurality of timers 14 are used is the same as that for the timer of FIG. 2. The synchronizing signal is filtered and converted to a pulse which is coupled to base two of the unijunction transistor 74. The synchronizing signal originates at the carry out terminal 110 of the decade counter 80. This signal changes from a low to a high whenever the count makes a transition from count 9 to count 0. Therefore, when the first of a series of timers of FIG. 3 in a string of synchronize timers makes the transition from count 9 to count 0, a synchronizing pulse is originated and provided at the synchronization terminal 16 for the other times 14 to synchronize on. The synchronization signal has one function in the timer of FIG. 3 that does not apply to the timer of FIG. 2. In addition to synchronizing the unijunction timer, the synchronizing signal must also reset the decade counters 80 so that all counters reset by coupling the synchronizing pulse through a small capacitor to the reset terminal 111 of the decade counter 80. Therefore, after the origin of the first synchronizing pulse, all interconnected timers of the FIG. 3 type will be reset to count 0 and their unijunction timers will be starting their timing sequence together.

Referring now to FIG. 4, the output from the timer is connected at terminal 44 to a suitable daylight control circuit 18, where it is inhibited during daylight hours and allowed to pass at night and is then fed to line 116. The timer signal from line 116 is then fed through some current amplification stages to transistor 118 which is the power switch for the lamp 22b which is in the operative position in the lens of the navigational light 10.

Of course, when the lamp 22b which is in the operative position burns out, it is desirable to sense this fault and actuate a lamp changing circuit to rotate a new bulb into the operative position. However, it is undesirable to sense the burned out lamp with a resistive element as this consumes power which can otherwise be used. The present lamp out sensing circuit includes a logic circuit including diodes 120 and 121; capacitor 122, resistors 123 and 124 and transistor 125. Diodes 120 and 121 are connected in configuration of a standard "or" gate. Under normal conditions when the lamp 22b is in the on condition, the anode of diode 121 is connected to a high and the anode of diode 120 is connected to a low. During the normal lamp off condition, the anode of diode 120 is high and the anode of diode 121 is low. Therefore, at all times during normal operating conditions, the anode of at least one of the two diodes 120 and 121 is connected to a high and so, due to diode action, there is always a high present at the junction of the two cathodes and resistors 123. During the time that the lamp 22b is off, the anode of diode 120 is connected to the positive voltage through the filament of the lamp 120. If the lamp 22b were burned out and the filament were open, there would be no path to provide positive voltage for the anode of diode 120. And since during the off time the anode of diode 121 is not connected to a high, if the lamp 22b is burned out, there is no longer a positive voltage available at re-

sistors 123 and 124. If the positive voltage is no longer available to transistor 125, the transistor 125 is forced to turn off. When the transistor 125 turns off, the collector of transistor 125 goes high. And it is the high on the collector of transistor that actuates the motor drive circuit.

The motor drive circuit 25 (FIG. 1) forms several major functions. This circuit drives the motor 28 forward to move a new bulb in the operative position in the navigational light. When a new lamp is moved into operational position, the circuit 26 reverses the polarity of the voltage applied to the motor 28 as will be more fully described. The motor is driven through a gear train and one-way clutch and even though the motor runs in reverse, it is not allowed to drive the turret backwards, but a reverse pulse to the motor 28 releases the forward pressure on the clutch and allows the electrical contact to make connection with a recess on the turret and by spring action to push to the bottom of the recess and cause the turret to achieve a straight up and accurately aligned position. Another major function of the motor drive circuit 26 is to interrupt the timer signal coming from the timer 14 during the time that the motor 28 is rotating and changing lamp bulbs. This, as will be described, insures that no power is applied to the turret while the electrical brush contact connections are being made or broken and thus prevent electrical arcing which may be dangerous, particularly in hazardous locations.

Continuing with a description of FIG. 4, the motor drive signal from the collector of transistor 125 is coupled through resistor 126 through the base of transistor 130. Transistor 130 is turned on causing the collector of transistor 130 to become low. The low on the collector of transistor 130 is coupled through a diode 131 to the junction of resistor 132 and capacitor 133. The negative pulse on the output of capacitor 133 is seen on the base of transistor 134 where it is a reverse bias and does not cause the transistor 134 to turn on. The negative pulse is then passed to ground through diode 135 and resistor 136. The low on the collector of transistor 130 is also seen at the junction of diode 137 and resistor 138 where it is used to perform two functions.

The low coupled through resistor 138 turns on npn transistor 139. With transistor 139 in the on state, a high is seen on resistor 140 and zener diode 141. The voltage from the junction of resistor 140 and diode 141 is transmitted over line 142 through diode 143 to forward bias transistor 144. With transistor 144 turned on, a path is completed to allow current to flow from the positive voltage 145 through transistor 144 through the motor 28 in a forward direction, through transistor 146 and then to ground. The motor 28 therefore is running in the forward position to replace the bulb 22b with a new bulb 22c.

The same low at the junction of diode 137 and resistor 138 which causes the motor 28 to move in the forward direction, is also seen through the diode 137 at the junction of resistors 150 and 151 and capacitors 152. This low is coupled through resistor 150 to forward bias transistor 153. With transistor 153 in the on condition, a high is made available to reverse bias the base-emitter junction of transistor 154 with transistor 154 held off by transistor 153, the timing signal on line 116 is inhibited and not allowed to turn on the transistor 118 which would apply power to the lamp circuit. Thus, it is now seen that when power is applied to the

motor drive circuit, the motor runs in the forward direction and the power is removed from the lamp circuit to prevent the possibility of the electrical contacts arcing and causing a spark in a hazardous location.

Of course, when a good lamp, for instance 22c, is rotated into position, a high is encountered at the anode of diode 120 again and transistor 130 is turned off forcing its collector high. The high on the collector of transistor 130 is seen at the junction of diode 137 and resistor 138. The high is seen through resistor 138 to the base of transistor 139 turning off transistor 139 and therefore turning off the voltage that drives the motor 28 in the forward direction. At the same time, the positive voltage at the junction of diode 137 and resistor 138 reverse biases diode 137. With diode 137 reversed biased, positive potential, after the delay of the combination of resistor 151 and capacitor 152, is applied to the base of transistor 153. The positive on the base of transistor 153 turns off transistor 153 and the timing signal on line 116 is no longer inhibited.

When the collector of transistor 130 goes high, diode 131 becomes reverse biased. With the diode 131 reversed biased, a positive potential through diode 160 and resistor 132 is seen at capacitor 133. This produces a positive spike that turns on transistor 134 for a short time. As long as transistor 134 is turned on, a low is seen through diode 161 that forward biases transistor 162. This same low is seen through resistor 163 to turn on transistor 164. With transistors 162 and 164 turned on, there is a path for current flow from positive voltage line 145 through transistor 164, through the motor 28 in the reverse direction and through transistor 162 to ground. Thus, it can be seen that when the motor drive is removed, the motor 28 will reverse its direction of rotation for a short time.

Referring now to FIGS. 5 through 8, a conventional lamp holding turret generally indicated by the reference numeral 170 is shown which generally holds a plurality of lamps, for example the lamps 22a through 22f of FIG. 1. Motor 28 drives the turret 170 through a one-way clutch 171. Metal contacts having a recess, preferably in the shape of a V-groove contact 172a through 172f are provided, one for each of the lamps 22a through 22f. A spring-loaded electrical brush contact 173 is provided preferably having a circular or ball point 174 which makes and breaks a contact with the V-grooves 172a through 172f to complete an electrical circuit to the bulb which is in the operative position. Thus, when the motor 28 rotates the turret 170 the electrical brush contact 173 contacts the proper V-shaped groove to provide power to the lamp in the operative position. When the lamp out circuit 24 detects a burned out filament, the motor 28 is energized to drive the turret through the one-way clutch 171 until the brush 173 contacts one of the V-shaped grooves and the lamp out detector circuit 24 measures a positive voltage through the filament of the new lamp now in the operative position stopping the motor. However, it is important that the turret 170 and the bulb in the operative position is accurately aligned since they are placed at the focal point of a lens system in a navigational light. Obviously, the width of the V-shaped groove 172a through 172f and the circular point 174 on the electrical brush 173 must be of a sufficient width to provide a good electrical contact. However, the motor 28 may have a certain amount of overrun and its electrical actuation and deactuation may not be suffi-

ciently accurate to correctly align the turret 170 and the operative bulb. Therefore, as previously described, when the motor 28 drives the turret 170 forward and finds a good lamp, a reverse polarity of voltage is applied to the motor 28. Even though the motor runs for a short period in reverse, it does not drive the turret backwards due to the action of the one-way clutch 171. However, the reversal of the motor does release the forward pressure on the clutch. With the pressure on the clutch released, the spring-loaded electrical brush 170 is sufficient to cause the ball point 170 to move the turret 170 a slight distance allowing the ball 174 to seek the apex 175 of the V-shaped groove of the lamp in the operative position thereby accurately causing the turret 170 to achieve a straight up position and accurately align the new bulb in the optical lens of the navigational light.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned as well as others inherent therein. While a presently preferred embodiment of the invention is given for the purpose of disclosure, numerous changes in the details of construction and arrangement of parts will readily suggest themselves to those skilled in the art and which are encompassed within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a navigational light having a power supply, a timer, a lamp-out sensing circuit, a lamp changing circuit having a rotating turret with lamps therein and a power brush which supplies power to contacts connected to the lamps, the improvement in a lamp changing circuit comprising,

switching means connected to and actuated by the lamp changing circuit, said switching means connected between the timer output and the power supply for disabling the timer signal from the lamp when actuated by the lamp changing circuit thereby preventing power from being supplied to the brush while the lamp changing circuit is rotating the turret thereby preventing electrical arcing between the brush and the contacts.

2. In a navigational light having a lamp changing circuit having a rotating turret containing a plurality of lamps and driven by a motor to place one of the lamps in an operative position in which electrical contacts connected to the lamps in the turret include a V-shaped recess and power is supplied to the recesses through a spring brush having a point, the improvement in the lamp changing circuit comprising,

a one-way clutch connected between the motor and the turret for providing a driving force to the turret in the forward direction but disconnecting the driv-

ing force of the motor from the turret when the motor is reversed,

means connected to the motor for indexing the turret when the lamp in the operative position is burned out to place a new lamp in the operative position, and

means for providing a reversing pulse to the motor at the end of the indexing movement for relieving all driving forces of the motor as the one-way clutch is reversed thereby allowing the point of the spring brush to seek the center of the V-shaped recess and accurately align the turret and operative lamp.

3. A navigational light having a power supply, a timer, a lamp changing circuit, a lamp filament circuit having a series connected power supply and power switch, a rotating turret containing a plurality of lamps and driven by a motor through a one-way clutch to place one of the lamps in an operative position in which electrical contacts connected to the lamps in the turret include a recess and power is supplied to the recesses through a spring brush comprising,

first switching means for actuating the lamp changing circuit,

a first electrical connection between the timer output and the switching means for supplying a signal to the switching means from the timer preventing actuation of the lamp changing circuit during the timing signal,

a second electrical connection connected between the lamp filament and the power switch for supplying a signal to the switching means when the lamp is unpowered by the timing signal for preventing actuation of the switching means but causing actuation of the switching means when the filament is burned out,

said lamp filament circuit having no current sensing resistive components,

second switching means connected to and actuated by the lamp changing circuit, said second switching means connected between the timer and the power supply for disabling the timer signal from the lamp when actuated thereby preventing power from being supplied to the brush while the lamp changing circuit is rotating the turret thereby preventing electrical arcing between the brush and the contacts.

4. The apparatus of claim 3 including,

means for providing a reversing pulse to the motor at the end of the indexing movement for relieving all driving forces of the motor as the one-way clutch is reversed thereby allowing the spring brush to seek the center of the recess and accurately align the turret and new operative lamp.

* * * * *