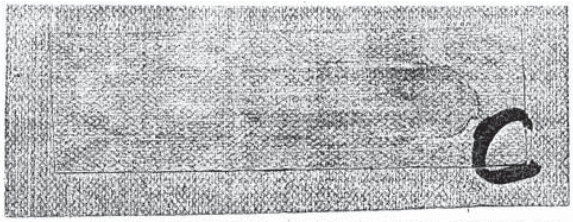

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SECTOR	CLASS	SUBCLASS	ART UNIT	EXAMINER
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☐ TERMINAL DISCLAIMER	DRAWINGS			CLAIMS ALLOWED	
	Sheets Drwg.	Figs. Drwg.	Print Fig.	Total Claims	Print Claim for O.G.
	8	10	1a	21	1

☐ a) The term of this patent subsequent to _____ (date) has been disclaimed.

THUY VINH TRAN (Assistant Examiner) 04/18/01 (Date)

NOTICE OF ALLOWANCE MAILED
04-24-01

☐ b) The term of this patent shall not extend beyond the expiration date of U.S Patent. No. _____

DAVID VU
PRIMARY EXAMINER
(Primary Examiner) 4/22/01 (Date)

ISSUE FEE

Amount Due	Date Paid
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☐ c) The terminal ____ months of this patent have been disclaimed.

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APPLICANT

JAMES RUXTON, TORONTO, CANADA.

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FOREIGN APPLICATIONS********
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Foreign Priority claimed / 35 USC 119 (a-d) conditions met / Verified and Acknowledged	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐yes ☑no ☐yes ☒no ☐Met after Allowance — Examiner's Initials: Thuy V Tran — Initials: T.T	CAX	8/10	30 33	4

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TITLE

VARIABLE-EFFECT LIGHTING SYSTEM

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PATENT APPLICATION TRANSMITTAL LETTER (Small Entity)	Docket No. T8464953US

TO THE ASSISTANT COMMISSIONER FOR PATENTS

Transmitted herewith for filing under 35 U.S.C. 111 and 37 C.F.R. 1.53 is the patent application of:

LAXTON, James

VARIABLE-EFFECT LIGHTING SYSTEM

Enclosed are:

- ☐ Certificate of Mailing with Express Mail Mailing Label No.
- ☒ **Eight** sheets of drawings.
- ☐ A certified copy of a application.
- ☒ Declaration ☒ Signed. ☐ Unsigned.
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Multiple Dependent Claims (check if applicable) ☐						$0.00
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Dated: **April 20, 1999**

Signature

Robert J. Graham
Reg. No. 43,430

cc:

P01SMALL/REV06

VARIABLE-EFFECT LIGHTING SYSTEM

FIELD OF THE INVENTION

The present invention relates to variable-effect lighting systems. In particular, the present invention relates to a lighting system having coloured lamps for producing a myriad of colour displays.

BACKGROUND OF THE INVENTION

Variable-effect lighting systems are commonly used for advertising, decoration, and ornamental or festive displays. Such lighting systems frequently include a set of coloured lamps packaged in a common fixture, and a control system which controls the output intensity of each lamp in order to control the colour of light emanating from the fixture.

For instance, Kunins (US Patent 2,515,236) teaches a coloured light source comprising a fixture having a red lamp, a green lamp, and blue lamp, with each lamp being connected to separate output terminal of an autotransformer. The autotransformer is connected to an AC voltage source, and the core of the autotransformer is rotated by a motor so as to vary the voltage applied to each lamp and thereby control the colour of light emanating from the fixture. Although the light source taught by Kunins may be suitable for producing light of varying colour, the use of a motor and autotransformer is bulky and is not suitable for producing intricate colour displays.

More recently, multi-coloured light-emitting diodes (LEDs) have been used with electronic switches to improve the versatility of the lighting system. For instance, Kazar (US Patent 5,008,595) teaches a light display comprising strings of bicoloured LED packages connected in parallel across a common DC voltage source. Each bicoloured LED package comprises a pair of red and green LEDs, connected back-

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to-back, with the bicoloured LED packages in each string being connected in parallel to the voltage source through an H-bridge circuit. A control circuit, connected to the H-bridge circuits, allows the red and green LEDS to conduct each alternate half cycle, with the conduction angle each half cycle being determined according to a modulating input source coupled to the control circuit. As a result, the bicolour LEDS can be forced to illuminate continuously, or to flash. Further, the colour of light produced by each bicolour LED can be continuously varied between two extremes.

Although the light display taught by Kazar offers an improvement over prior variable-effect lighting systems, the control system and the H-bridge circuitry increases the complexity of the lighting system. Further, the rate of change of coloured light produced is restricted by the modulating input source. Therefore, the range of colour displays which can be produced by the light display is limited.

Phares (US Patent 5,420,482) teaches a controlled lighting system which allows a greater range of colour displays to be realized. The lighting system comprises a control system which transmits illumination data to a number of lighting modules. Each lighting module includes at least two lamps and a control unit connected to the lamps and responsive to the illumination data to individually vary the amount of light emitted from each lamp. However, the illumination data only controls the brightness of each lamp at any given instant. Therefore, the lighting system is not particularly well suited to easily producing intricate colour displays.

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Murad (US Patent 4,317,071) teaches a computerized illumination system for producing a continuous variation in output colour. The illumination system comprises a number of different coloured lamps, a low frequency clock, and a control circuit connected to the low frequency clock and to each coloured lamp for varying the intensity of light produced by each lamp. However, the rate of change of lamp intensity is dictated by the frequency of the low frequency clock, and the range of colour displays is limited.

Accordingly, there remains a need for a relatively simple variable-effect lighting system which allows for greater variation in the range of colour displays which can be realized.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a variable-effect lighting system which addresses the deficiencies of the prior art lighting systems.

The variable-effect lighting system, according to the invention, comprises a lamp assembly, and a programmable lamp controller. The lamp assembly includes a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light. The programmable lamp controller is coupled to the lamp assembly for setting the conduction angle of the illuminating elements according to at least one predetermined pattern stored in a memory of the lamp controller. Preferably, the controller includes a user-operable input to allow the user to select the predetermined pattern and hence the colour display as desired. Alternately, the controller includes a temperature sensor for selecting the predetermined pattern according to ambient temperature, or a clock circuit for selecting the predetermined pattern according to the time.

In one embodiment of the invention, the programable lamp controller comprises a microcontroller for setting the conduction angle according to a plurality of user-selectable predetermined patterns. The lamp assembly comprises a string of series-connected bicoloured light-emitting diodes connected in series between an AC power source and an electronic switch. The electronic switch is coupled to an output of the microcontroller and sets the conduction angle of the illuminating elements of each bicoloured light-emitting diode according to the predetermined pattern selected.

In another embodiment of the invention, the lamp assembly comprises at least one bicoloured light-emitting diode coupled to a DC power source. The first illuminating element of the bicoloured light-emitting diode is coupled to the DC power source through a first electronic switch, and the second illuminating element of the bicoloured light-emitting diode is coupled to the DC power source through a second electronic switch. The electronic switches are each coupled to a respective output of the programmable controller for setting the conduction angles of the illuminating elements.

In yet another embodiment of the invention, the lamp assembly comprises at least one bicoloured light-emitting diode, with each illuminating element of the bicoloured light-emitting diode being driven directly by a respective output of the programmable controller.

Applications of the invention include Christmas tree light strings, temperature-sensitive lights, night lights, jewelry, key chains and decorative lighting displays.

BRIEF DESCRIPTION OF THE DRAWINGS

The preferred embodiments of the invention will now be described, by way of example only, with reference to the drawings, in which:

Fig. 1a is a schematic circuit diagram of a variable-effect lighting system according to a first embodiment of the invention, showing a programmable controller, and a lamp assembly comprising a string of series-coupled bicoloured lamps;

Fig. 1b is a schematic circuit diagram of one variation of the lamp assembly shown in Fig. 1a;

Fig. 1c is a schematic circuit diagram of another variation of the lamp assembly shown in Fig. 1a;

Fig. 2a is a schematic circuit diagram of a variable-effect lighting system according to a second embodiment of the invention, wherein the lamp assembly comprises a string of parallel-coupled bicoloured lamps;

Fig. 2b is a schematic circuit diagram of one variation of the lamp assembly shown in Fig. 2a;

Fig. 2c is a schematic circuit diagram of one variation of the variable-effect lighting system shown in Fig. 2a;

Fig. 3 is a schematic circuit diagram of a variable-effect lighting system according to a third embodiment of the invention, wherein the programmable controller directly drives each bicoloured lamp;

Fig. 4 is a night light according to one implementation of the embodiment shown in Fig. 2;

Fig. 5a is a jewelry piece according to one implementation of the embodiment shown in Fig. 3; and

Fig. 5b is a key chain according to another implementation of the embodiment shown in Fig. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning to Fig. 1a, a variable-effect lighting system according to a first embodiment of the invention, denoted generally as 10, is shown comprising a lamp assembly 11, and a programmable lamp controller 12 coupled to the lamp assembly 11 for setting the colour of light produced by the lamp assembly 11. Preferably, the lamp assembly 11 comprises string of multi-coloured lamps 14 interconnected with flexible wire conductor to allow the ornamental lighting system 10 to be used as decorative Christmas tree lights. However, the multi-coloured lamps 14 may also be interconnected with substantially rigid wire conductor or affixed to a substantially rigid backing for applications requiring the lamp assembly 11 to have a measure of rigidity.

The multi-coloured lamps 14 are connected in series with each other and with an AC voltage source 16, and a current-limiting resistor 18. Typically the AC voltage source 16 comprises the 60 Hz 120 VAC source commonly available. However, other sources of AC voltage may be used without departing from the scope of the invention. As will be appreciated, the series arrangement of the lamps 14 eliminates the need for a step-down transformer between the AC voltage source 16 and the lamp assembly 11. The current-limiting resistor 18 limits the magnitude of current flowing through the lamps 14. However, the current-limiting resistor 18 may be eliminated if a sufficient number of lamps 14 are used, or if the magnitude of the voltage produced by the AC voltage source 16 is selected so that the lamps 14 will not be exposed to excessive current flow.

For longevity, each lamp 14 comprises a bicoloured LED having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light which is different from the first colour, and with the leads of each lamp 14 disposed such that when current flows through the lamp 14 in one direction the first colour of light is produced, and when current flows through the lamp 14 in the opposite direction the second colour of light is produced. As shown in Fig. 1a, preferably each bicoloured LED comprises a pair of differently-coloured LEDs 14a, 14b

connected back-to-back, with the first illuminating element comprising the LED 14a and the second illuminating element comprising the LED 14b.

In a preferred implementation of the invention, the first illuminating element produces red light, and the second illuminating element produces green light. However, other LED colours may be used if desired. In addition, both LEDs 14a, 14b of some of the lamps 14 may be of the same colour if it is desired that some of the lamps 14 vary the intensity of their respective colour outputs only. Further, each lamp 14 may be fitted with a translucent ornamental bulb shaped as a star, or a flower or may have any other aesthetically pleasing shape for added versatility.

The programmable controller 12 comprises a microcontroller 20, a bidirectional semiconductor switch 22 controlled by an output Z of the microcontroller 20, and a user-operable switch 24 coupled to an input S of the microcontroller 20 for selecting the colour display desired. In addition, an input X of the microcontroller 20 is coupled to the AC voltage source 16 through a current-limiting resistor 26 for synchronization purposes, as will be described below. The bidirectional switch 22 is positioned in series with the lamps 14, between the current limiting resistor 18 and ground. In Fig. 1, the bidirectional switch 22 is shown comprising a triac switch. However, other bidirectional switches, such as IGBTs or back-to-back SCRs, may be used without departing from the scope of the invention.

The programmable controller 12 is powered by a 5-volt DC regulated power supply 28 connected to the AC voltage source 16 which ensures that the microcontroller 20 receives a steady voltage supply for proper operation. However, for added safety, the programmable controller 12 also includes a brownout detector 30 connected to an input Y of the microcontroller 20 for placing the microcontroller 20 in a stable operational mode should the supply voltage to the microcontroller 20 drop below acceptable limits.

The microcontroller 20 includes a non-volatile memory which is programmed or "burned-in" with preferably several conduction angle patterns for setting the conduction angle of the bidirectional switch 22 in accordance with the pattern selected. In this manner, the conduction angles of the LEDs 14a, 14b (and hence the colour display generated by the bicoloured lamps 14) can be selected.

Preferred colour displays include, but are not limited to:

1. continuous slow colour change between red, amber and green
2. continuous rapid colour change between red, amber and green
3. continuous alternate flashing of red and green
4. continuous random flashing of red and green
5. continuous illumination of red only
6. continuous change in intensity of red
7. continuous flashing of red only
8. continuous illumination of green only
9. continuous change in intensity of green
10. continuous flashing of green only
11. continuous illumination of red and green to produce amber
12. combination of any of the preceding colour displays

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However, as will be appreciated, the microcontroller 20 needs only be programmed with a single conduction angle pattern to function. Further, ~~the microcontroller 20 can also be programmed~~ in situ with a user interface (not shown) /a/ for increased flexibility. As will be apparent, if the microcontroller 20 is programmed with only a single conduction angle pattern, the user-operable switch 24 may be eliminated from the programmable controller 12. Further, the user-operable switch 24 may be eliminated even when the microcontroller 20 is programmed with a number of conduction angle patterns, with the microcontroller 20 automatically switching between the various conduction angle

patterns. Alternately, the user-operable switch 24 may be replaced with a clock circuit which signals the microcontroller 20 to switch conduction angle patterns according to the time.

The operation of the variable-effect lighting system 10 will now be described. Prior to power-up of the lighting system 10, the microcontroller 20 is programmed with at least one conduction angle pattern. Alternately, the microcontroller 20 is programmed after power-up using the above-described user interface. Once power is applied through the AC voltage source 16, the 5-volt DC regulated power supply 28 provides power to the microcontroller 20 and the brown-out detector 30.

After the brown-out detector 30 signals the microcontroller 20 at input Y that the voltage supplied by the power supply 28 has reached the threshold sufficient for proper operation of the microcontroller 20, the microcontroller 20 begins executing instructions for implementing a default conduction angle pattern. However, if a change of state is detected at the input S by reason of the user activating the user-operable switch 24, the microcontroller 20 will begin executing instructions for implementing the next conduction angle pattern. For instance, if the microcontroller 20 is executing instructions for implementing the third conduction angle pattern identified above, actuation of the user-operable switch 24 will force the microcontroller 20 to being executing instructions for implementing the fourth conduction angle pattern.

For ease of explanation, it is convenient to assume that the LED 14a is a red LED, and the LED 14b is a green LED. It is also convenient to assume that the first conduction angle pattern, identified above, is selected. The operation of the lighting system 10 for the remaining conduction angle patterns will be readily understood from the following description by those skilled in the art.

After the conduction angle pattern is selected, either by default or by reason of activation of the user-operable switch 24, the microcontroller 20 will begin monitoring the AC signal received at the input X to the microcontroller 20. Once a positive-going zero-crossing of the AC voltage source 16 is detected, the microcontroller 20 delays a predetermined period. After the predetermined period has elapsed, the microcontroller 20 issues a pulse to the bidirectional switch 22, causing the bidirectional switch 22 to conduct current in the direction denoted by the arrow 32. As a result, the red LED 14a illuminates until the next zero-crossing of the AC voltage source 16. In addition, while the LED 14a is conducting current, the predetermined period for the LED 14a is increased in preparation for the next positive-going zero-crossing of the AC voltage source 16.

After the negative-going zero-crossing of the AC signal source 16 is detected at the input X, the microcontroller 20 again delays a predetermined period. After the predetermined period has elapsed, the microcontroller 20 issues a pulse to the bidirectional switch 22, causing the bidirectional switch 22 to conduct current in the direction denoted by the arrow 34. As a result, the green LED 14b illuminates until the next zero-crossing of the AC voltage source 16. In addition, while the LED 14b is conducting current, the predetermined period for the LED 14b is decreased in preparation for the next negative-going zero-crossing of the AC voltage source 16.

With the above conduction angle sequence, it will be apparent that the period of time each cycle during which the red LED 14a illuminates will continually decrease, while the period of time each cycle during which the green LED 14b illuminates will continually increase. Therefore, the colour of light emanating from the bicoloured lamps 14 will gradually change from red, to amber, to green, with the colour of light emanating from the lamps 14 when both the LEDs 14a, 14b are conducting being determined by the instantaneous ratio of the magnitude of the conduction angle of the LED 14a to the magnitude of the conduction angle of the LED 14b.

When the conduction angle of the green LED 14b reaches 180°, the conduction angle pattern is reversed so that the colour of light emanating from the bicoloured lamps 14 changes from green, to amber and back to red. As will be appreciated, the maximum conduction angles for each conducting element of the lamps 14 can be set less than 180° if desired.

In a preferred implementation of the invention, the microcontroller 20 comprises a Microchip PIC12C508 microcontroller. The zero-crossings of the AC voltage source 16 are detected at pin 3, the state of the user-operable switch 24 is detected at pin 7, and the bidirectional switch 22 is controlled by pin 6. The brown-out detector 30 is coupled to pin 4. The assembly code listing for generating conduction angle patterns 1,2 and 3 with the Microchip PIC12C508 microcontroller is shown in Table A.

TABLE A

```
; Constants

        AC_IN EQU 4;        GP4 (pin 3) is AC input pin X
        TRIGGER_OUT EQU 1; GP1 (pin 6) is Triac Trigger pin Z
        BUTTON EQU 0; GP0 (pin 7) is Button 24 input pin S and is active low

        delay_dim EQU 0x007
        dim_val EQU 0x008
        trigger_delay EQU 0x009
        DELAY1 EQU 0x00A
        DELAY2 EQU 0x00B
        DELAY3 EQU 0x00C
        RED_INTENSITY EQU 0x00D
```

```
        SUBTRACT_REG EQU 0x00E
        DELAY5 EQU 0x00F
        FLASH_COUNT EQU 0x010
        FLASH_COUNT_SHAD EQU 0x011
        FADE_DELAY EQU 0x012


        org 0;          RESET vector location
        movwf OSCCAL;   move data from W register to OSCCAL
        goto START

DELAY;      subroutine to delay 83 usec * register W

        movwf dim_val;
LOOP1
        movlw .27
        movwf delay_dim
LOOP2;              delay 83 usec
        decfsz delay_dim,1
        goto LOOP2
        decfsz dim_val,1
        goto LOOP1
return

TRIGGER;    subroutine to send trigger pulse to triac
        bsf GPIO,TRIGGER_OUT
            movlw b'00010001'
            TRIS GPIO;          send trigger to triac
        movlw .30
```

```
        movwf trigger_delay
LOOP3
        decfsz trigger_delay,1
        goto LOOP3;                 delay 30 usec
        movlw b'00010011'
        TRIS GPIO;                  remove trigger from triac
return

DELAY_SEC
        movlw .4
        movwf DELAY3;       set DELAY3
SEC2
        movlw .250
        movwf DELAY2;       set DELAY2
QUART_SEC2
        movlw .250
        movwf DELAY1;       set DELAY1
MSEC2
        clrwdt;             clear Watchdog timer
        decfsz DELAY1,1;    wait DELAY1
        goto MSEC2
        decfsz DELAY2,1;    wait DELAY2 * DELAY1
        goto QUART_SEC2
        decfsz DELAY3,1;    wait DELAY3 * DELAY2 * DELAY1
        goto SEC2
return

FADE_SUB;           subroutine to vary conduction angle for triac each half cycle
```

```
UP_LOOP;            increase delay before triac starts to conduct each negative half
                    cycle while decreasing delay each positive half cycle
        btfss GPIO,AC_IN
        goto UP_LOOP;       wait for positive swing on AC input
WAIT_NEG1
        call WAIT_NEG_EDGE1;    increase delay before turning triac on each negative
                                half cycle
NO_CHANGE
        movlw .90;          register W = maximum delay value before triac turns on
        subwf RED_INTENSITY,0
        btfsc STATUS,Z
        goto WAIT_NEG2;     if RED_INTENSITY is equal to maximum delay value,
                            start increasing delay value
        movf RED_INTENSITY,0
        btfss GPIO,BUTTON
return;                     return if Button depressed
        call DELAY;         delay RED_INTENSITY * 83 usec
        call TRIGGER;       send trigger pulse to triac
MAIN_LOOP2
        btfsc GPIO,AC_IN
        goto MAIN_LOOP2;    wait for negative swing on AC input
WAIT_POS_EDGE1
        btfss GPIO,AC_IN
        goto WAIT_POS_EDGE1;    wait for positive swing on AC input
        movlw .96
        movwf SUBTRACT_REG;         SUBTRACT_REG = maximum delay value
                                    + minimum delay value before triac turns on
        movf RED_INTENSITY,0
        subwf SUBTRACT_REG,0
```

```
        call DELAY;          delay (SUBTRACT_REG - RED_INTENSITY) * 83 usec
        call TRIGGER;        send trigger pulse to triac
        goto UP_LOOP

DOWN_LOOP
        btfss GPIO,AC_IN
        goto DOWN_LOOP;  wait for positive swing on AC input
WAIT_NEG2
        call WAIT_NEG_EDGE2;     decrease delay before triac turns on each negative
                                 half cycle
NO_CHANGE2
        movlw .6
        subwf RED_INTENSITY,0;   register W = RED_INTENSITY - minimum delay
                                 value
        btfsc STATUS,Z
        goto WAIT_NEG1;          if RED_INTENSITY is equal to minimum delay
                                 value, start increasing delay
        movf RED_INTENSITY,0
        btfss GPIO,BUTTON
return;                      return if Button depressed
        call DELAY;          delay RED_INTENSITY * 83 usec
        call TRIGGER;        send trigger pulse to triac
MAIN_LOOP3
        btfsc GPIO,AC_IN
        goto MAIN_LOOP3; wait for negative swing on AC input
WAIT_POS_EDGE2
        btfss GPIO,AC_IN
        goto WAIT_POS_EDGE2;     wait for positive swing on AC input
        movlw .96
```

```
        movwf SUBTRACT_REG;   SUBTRACT_REG = maximum delay value before
                              triac turns on
        movf RED_INTENSITY,0
        subwf SUBTRACT_REG,0
        call DELAY;           delay (SUBTRACT_REG - RED_INTENSITY) * 83 usec
        call TRIGGER;         send trigger pulse to triac
        goto DOWN_LOOP
return

WAIT_NEG_EDGE1;               routine to increase delay before triac turns on each negative
                              half cycle
        btfsc GPIO,AC_IN;     wait for negative swing on AC input
        goto WAIT_NEG_EDGE1
        decfsz DELAY5,1;      DELAY5 = fade delay, ie number of cycles at present delay
                              value; decrement and return if not zero
return
        incf RED_INTENSITY,1; otherwise, increment delay and return
        movf FADE_DELAY,0
        movwf DELAY5
return

WAIT_NEG_EDGE2;               routine to decrease delay before triac turns on each negative
                              half cycle
        btfsc GPIO,AC_IN;     wait for negative swing on AC input
        goto WAIT_NEG_EDGE2
        decfsz DELAY5,1;      DELAY5 = number of cycles at present delay value;
                              decrement and return if not zero
return
        decf RED_INTENSITY,1; otherwise, decrement delay and return
```

```
        movf FADE_DELAY,0
        movwf DELAY5;           DELAY5 = FADE_DELAY
return

5   FLASH_SUB;      subroutine to flash lights at speed dictated by value assigned to
                    FLASH_COUNT_SHAD
        movf FLASH_COUNT_SHAD,0
        movwf FLASH_COUNT;      FLASH_COUNT = duration of flash
MAIN_LOOP4
10      btfsc GPIO,AC_IN ;      wait for negative swing on AC input
        goto MAIN_LOOP4
WAIT_POS_EDGE4
        btfss GPIO,AC_IN
        goto WAIT_POS_EDGE4;    wait for positive swing on AC input
15      movlw .6
        call DELAY
        call TRIGGER;           send trigger pulse to triac
        btfss GPIO,BUTTON
return ;                        return if Button pressed
20      decfsz FLASH_COUNT
        goto MAIN_LOOP4;        decrement FLASH_COUNT and repeat until zero
        movf FLASH_COUNT_SHAD,0
        movwf FLASH_COUNT;      reset FLASH_COUNT
DOWN_LOOP4
25      btfss GPIO,AC_IN ;      wait for positive swing on AC input
        goto DOWN_LOOP4
WAIT_NEG_EDGE4
        btfsc GPIO,AC_IN
        goto WAIT_NEG_EDGE4;    wait for negative swing on AC input
```

```
        movlw .6
        call DELAY
        call TRIGGER                send trigger pulse to triac
        btfss GPIO,BUTTON
5   return ;                        return if Button pressed
        decfsz FLASH_COUNT
        goto DOWN_LOOP4;            decrement FLASH_COUNT and repeat until zero
    return

10  START
        movlw b'00010011'
        TRIS GPIO;  set pins GP4 (AC input), GP1 (Triac output to high impedance),
                    GP0 (Button as input)
        movlw b'10010111'; enable pullups on GP0, GP1, GP3
15  OPTION
        movlw .4
        movwf RED_INTENSITY;    load RED_INTENSITY register
        movlw .5
        movwf DELAY5;       set initial fade
20
    FADE_SLOW
        call DELAY_SEC;     wait DELAY3 * DELAY2 * DELAY1
        movlw .5
        movwf FADE_DELAY;       set slow FADE_DELAY
25      call FADE_SUB ;     slowly fade colours until Button is pressed
        goto FADE_FAST

    FADE_FAST
        call DELAY_SEC;     wait DELAY3 * DELAY2 * DELAY1
```

```
        movlw .1
        movwf FADE_DELAY;       set fast FADE_DELAY
        call FADE_SUB;      rapidly fade colours until Button is pressed
        goto FLASH2_SEC
5
    FLASH2_SEC ; flash red/green 2 sec interval
        call DELAY_SEC;     wait DELAY3 * DELAY2 * DELAY1
        movlw .120
        movwf FLASH_COUNT_SHAD
10  FLASH2B_SEC
        btfss GPIO,BUTTON
        goto FLASH1_SEC;  slowly flash lights until Button is pressed
        call FLASH_SUB
        goto FLASH2B_SEC
15
    FLASH1_SEC ; flash red/green 1 sec. interval
        call DELAY_SEC;     wait DELAY3 * DELAY2 * DELAY1
        movlw .60
        movwf FLASH_COUNT_SHAD
20  FLASH1B_SEC
        btfss GPIO,BUTTON
        goto FLASH_FAST;  flash lights at moderate speed until Button is pressed
        call FLASH_SUB
        goto FLASH1B_SEC
25
    FLASH_FAST ; flash red/green 0.25 sec. interval
        call DELAY_SEC;     wait DELAY3 * DELAY2 * DELAY1
        movlw .15
        movwf FLASH_COUNT_SHAD
```

```
FLASH_FASTB
        btfss GPIO,BUTTON
        goto FADE_SLOW;   rapidly flash lights until Button is pressed
        call FLASH_SUB;   slowly fade colours if Button is pressed
        goto FLASH_FASTB

end
```

Numerous variations of the lighting system 10 are possible. In one variation (not shown), the user-operable switch 24 is replaced with a temperature sensor coupled to the input S of the microcontroller 20 for varying the conduction angle pattern according to the ambient temperature. Alternately, the programmable lamp controller 12 includes a plurality of temperature sensors, each being sensitive to a different temperature range, and being coupled to a respective input of the microcontroller 20. With these variations, one colour display is produced when the ambient temperature falls within one range and another colour display is produced when the ambient temperature falls within a different range.

In another variation (not shown), each lamp 14 comprises a pair of LEDs with one of the LEDs being capable of emitting white light and with the other of the LEDs being capable of producing a colour of light other than white. In still another variation, each lamp 14 comprises a LED capable of producing three or more different colours of light, while in the variation shown in Fig. 1b, each lamp 14 comprises three or more differently-coloured LEDs. In these latter two variations, the LEDs are connected such that when current flows in one direction one colour of light is produced, and when current flows in the opposite direction another colour of light is produced.

In yet another variation, shown in Fig. 1c, the programmable lamp controller 12 comprises two bidirectional switches 22a, 22b each connected to a respective output Z1,

Z2 of the microcontroller 20. The lamp assembly 11 comprises first and second strings 11a, 11b of series-connected back-to-back-coupled LEDs 14a, 14b, with each string 11a, 11b being connected to the AC voltage source 16 and to a respective one of the bidirectional switches 22a, 22b. In this variation, each multi-coloured lamp14 comprises one pair of the back-to-back-coupled LEDs 14a, 14b of the first string 11a and one pair of the back-to-back-coupled LEDs 14a, 14b of the second string 11b, with the LEDs of each lamp 14 being inserted in a respective translucent ornamental bulb. As a result, the colour of light emanating from each bulb depends on the instantaneous ratio of the conduction angles of the LEDs 14a, 14b in both strings 11a, 11b. Preferably, the outputs Z1, Z2 are independently operable to increase the range of colour displays.

In a further variation, the programmable lamp controller 12 is similar to the programmable lamp controller 12 shown in Fig. 1c, in that it comprises two bidirectional switches 22a, 22b each connected to a respective independently-operable output Z1, Z2 of the microcontroller 20. However, unlike the programmable lamp controller 12 shown in Fig. 1c, the lamp assembly 11 comprises first and second strings 11a, 11b of series-connected singly-coloured lamps 14. As above, each singly-coloured lamp 14 of the first string 11a is associated with a singly-coloured lamp 14 of the second string 11b, with each associated lamp pair being inserted in a respective translucent ornamental bulb.

Turning to Fig. 2a, a variable-effect lighting system according to a second embodiment of the invention, denoted generally as 110, is shown comprising a lamp assembly 111, and a programmable lamp controller 112 coupled to the lamp assembly 111 for setting the colour of light produced by the lamp assembly 111.

The lamp assembly 111 comprises a string of multi-coloured lamps 114 connected in parallel with each other. The multi-coloured lamps 114 are also connected in parallel with an AC/DC converter 116 which is coupled to an AC voltage source. Each lamp 114 comprises a bicoloured LED having a first illuminating element for producing a first

colour of light, and a second illuminating element for producing a second colour of light which is different from the first colour, with the leads of each lamp 114 configured such that when current flows through one lead the first colour of light is produced, and when current flows through the another lead the second colour of light is produced. As shown in Fig. 2a, preferably each bicoloured LED comprises first and second differently-coloured LEDs 114a, 114b in series with a respective current-limiting resistor 118, with the common cathode of the LEDs 114 being connected to ground, and with the first illuminating element comprising the first LED 114a and the second illuminating element comprising the second LED 114b.

The AC/DC converter 116 produces a DC output voltage of a magnitude which is sufficient to power the lamps 114, but which will not damage the lamps 114. Typically, the AC/DC converter 116 receives 120 volts AC at its input and produces an output voltage of about 5 volts DC.

The programmable controller 112 is also powered by the output of the AC/DC converter 116 and comprises a microcontroller 20, a first semiconductor switch 122 controlled by an output Z1 of the microcontroller 20, a second semiconductor switch 123 controlled by an output Z2 of the microcontroller 20, and a user-operable switch 24 coupled to an input S of the microcontroller 20 for selecting the colour display desired. As discussed above, the user-operable switch 24 may be eliminated if desired. In Fig. 2a, the semiconductor switches 122, 123 are shown comprising MOSFET switches. However, other semiconductor switches may be used without departing from the scope of the invention.

The first semiconductor switch 122 is connected between the output of the AC/DC converter 116 and the anode of the first LED 114a (through the first current-limiting resistor 118), while the second semiconductor switch 123 is connected between the output of the AC/DC converter 116 and the anode of the second LED 114b (through the second current-limiting resistor 118). However, the anodes of the LEDs 114a, 114b may

be coupled instead to the output of the AC/DC converter, with the first and second semiconductor switches 122, 123 being connected between the respective cathodes and ground. Other variations on the placement of the semiconductor switches 122, 123 will be apparent to those skilled in the art.

As with the previously described embodiment, the microcontroller 20 includes a non-volatile memory which is programmed with preferably several conduction angle sequences for setting the firing angle of the semiconductor switches 122, 123 in accordance with the sequence selected. In this manner, the conduction angles of the LEDs 114a, 114b, and hence the ultimate colour display generated by the lamps 114 can be selected.

The operation of the variable-effect lighting system 110 is similar to the operation of the variable-effect lighting system 10. After power is applied to the AC/DC converter 116, the microcontroller 20 begins executing instructions for implementing one of the conduction angle sequences. Again, assuming that the first conduction angle sequence, identified above, is selected, the microcontroller 20 issues a signal to the first semiconductor switch 122, causing the first LED 114a to illuminate. After a predetermined period has elapsed, the signal to the first semiconductor switch 122 is removed, causing the first LED 114a to extinguish. While the LED 114a is conducting current, the predetermined period for the first LED 114a is decreased in preparation for the next cycle.

The microcontroller 20 then issues a signal to the second semiconductor switch 123, causing the second LED 114b to illuminate. After a predetermined period has elapsed, the signal to the second semiconductor switch 123 is removed, causing the second LED 114b to extinguish. While the second LED 114b is conducting current, the predetermined period for the second LED 114b is increased in preparation for the next cycle.

With the above conduction angle sequence, it will be apparent that the period of time each cycle during which the first LED 114a illuminates will continually decrease, while the period of time each cycle during which the second LED 114b illuminates will continually increase. Therefore, the colour of light emanating from the lamps 114 will gradually change from the colour of the first LED 114a to the colour of the second LED 114b, with the colour of light emanating from the lamps 114 when both the LEDs 114a, 114b are conducting being determined by the instantaneous ratio of the magnitude of the conduction period of the first LED 114a to the magnitude of the conduction period of the second LED 114b.

Numerous variations of the lighting system 110 are also possible. In one variation, each lamp 114 comprises a pair of LEDs with one of the LEDs being capable of emitting white light and with the other of the LEDs being capable of producing a colour of light other than white. In another variation, each lamp 114 comprises a LED capable of producing three or more different colours of light, while in the variation shown in Fig. 2b, each lamp 114 comprises three or more differently-coloured LEDs. In these latter two variations, the LEDs are connected such that when current flows through one of the semiconductor switches one colour of light is produced, and when current flows through the other of the semiconductor switches another colour of light is produced. In yet another variation, shown in Fig. 2c, the programmable controller 112 includes a first pair of electronic switches 122a, 122b driven by the output Z1 of the microcontroller 20, and a second pair of electronic switches 123a, 123b driven by the output Z1 of the microcontroller 20. Each pair of first and second LEDs 114a, 114b of each lamp 114 are connected back-to-back, such that the lamps 114 and the semiconductor switches 122, 123 are configured together as an H-bridge. As discussed above, preferably the first and second LEDs 114a, 114b produce different colours, although the invention is not intended to be so limited.

Turning to Fig. 3, a variable-effect lighting system according to a third embodiment of the invention, denoted generally as 210, is shown comprising a multi-coloured lamp 214,

and a programmable lamp controller 212 coupled to the multi-coloured lamp 214 for setting the colour of light produced by the lamp 214. The multi-coloured lamp 114 comprises a bicoloured LED having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light which is different from the first colour. As shown in Fig. 3, preferably the first illuminating element comprises a red-coloured LED 214a, and the second illuminating element comprises a green-coloured LED 214b, with the common cathode of the LEDs 214a, 214b being connected to ground. As discussed above, multi-coloured LEDs and/or arrangements of differently-coloured discrete LEDs and/or translucent ornamental bulbs may be used if desired.

The programmable controller 212 is powered by a 9-volt battery 216, and comprises a microcontroller 20, and a user-operable switch 24 coupled to an input S of the microcontroller 20 for selecting the colour display desired. Alternately, for applications where space is at a premium, the programmable controller 212 may be powered by a smaller battery producing a smaller voltage. If necessary, the smaller battery may be coupled to the programmable controller 212 through a voltage amplifier, such as a DC-to-DC converter. As discussed above, the user-operable switch 24 may also be eliminated if desired.

An output Z1 of the microcontroller 20 is connected to the anode of the red LED 214a, and an output Z2 of the microcontroller 20 is connected to the anode of the green LED 214b. Since the lamp 214 is driven directly by the microcontroller 20, the variable-colour ornamental lighting system 210 is limited to applications requiring only a small number of lamps 214.

The operation of the variable-effect lighting system 210 will be readily apparent from the foregoing discussion and, therefore, need not be described.

Turning now to Fig. 4, a night light 310 is shown comprising the variable-effect lighting system 110, described above, but including only a single multi-coloured lamp 114, a housing 340 enclosing the programmable controller 112 and the AC/DC converter 116, and a translucent bulb 342 covering the lamp 114 and fastened to the housing 340. Preferably, the housing 340 also includes an ambient light sensor 344 connected to the microcontroller 20 for inhibiting conduction of the lamp 114 when the intensity of ambient light exceeds a threshold.

In Fig. 5a, a jewelry piece 410, shaped as a ring, is shown comprising the variable-effect lighting system 210, described above, and a housing 440 retaining the lamp 214, the programmable controller 212, and the battery 216 therein. A portion 442 of the housing 440 is translucent to allow light to be emitted from the lamp 214. In Fig. 5b, a key chain 510, is shown comprising the variable-colour ornamental lighting system 210, and a housing 540 retaining the lamp 214, the programmable controller 212, and the battery 216 therein. A portion 542 of the housing 540 is translucent to allow light to be emitted from the lamp 214. A key clasp 544 is coupled to the housing 540 to retain keys. Both the jewelry piece 410 and the key chain 510 may optionally include a user-operable input for selecting the conduction angle pattern.

The foregoing description of the preferred embodiments is intended to be illustrative of the present invention. Those of ordinary skill will be able to envision certain additions, deletions and/or modifications to the described embodiments without departing from the spirit or scope of the invention as defined by the appended claims.

I CLAIM:

1. A variable-effect lighting system comprising:

a lamp assembly comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light; and

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller.

2. The lighting system according to claim 1, wherein the at least one pattern is selectable according to a user-operable input to the controller.

3. The lighting system according to claim 1, wherein the lamp controller includes a temperature sensor for selecting the at least one pattern.

4. The lighting system according to claim 1, wherein the lamp controller includes a clock circuit for selecting the at least one pattern.

5. The lighting system according to claim 1, wherein the lamp assembly comprises a plurality of series-connected multi-coloured lamps, the multi-coloured lamps being in series with an AC power source.

6. The lighting system according to claim 5, wherein each said multi-coloured lamp comprises a pair of light-emitting diodes connected back-to-back, a first light-emitting diode of the light-emitting diode pair comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

7. The lighting system according to claim 5, wherein the multi-coloured lamps are connected in series with the AC power source and an electronic switch, the electronic switch being coupled to an output of the programmable controller for setting the conduction angle of the multi-coloured lamps.

8. The lighting system according to claim 6, wherein the first and second light-emitting diodes are connected in series with the AC power source and an electronic switch, the electronic switch being coupled to an output of the programmable controller for setting the conduction angle of the first and second light-emitting diodes.

9. The lighting system according to claim 1, wherein the first colour is different from the second colour.

10. The lighting system according to claim 1, wherein the lamp assembly comprises at least one multi-coloured lamp coupled in parallel to a DC power source.

11. The lighting system according to claim 10, wherein each said multi-coloured lamp comprises a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the light-emitting diode pair comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

12. The lighting system according to claim 10, wherein the first illuminating element of each said multi-coloured lamp is coupled to the DC power source through a first electronic switch, and the second illuminating element of each said multi-coloured lamp is coupled to the DC power source through a second electronic switch, the first and second electronic switches being coupled to the programmable controller for setting the conduction angle of the multi-coloured lamps.

13. The lighting system according to claim 11, wherein the anode of each said first light-emitting diode is coupled to the DC power source through a first electronic switch, and the anode of each said second light-emitting diode is coupled to the DC power source through a second electronic switch, the first and second switches being coupled to the programmable controller for setting the conduction angle of the first and second light-emitting diodes.

14. The lighting system according to claim 13, wherein the first and second electronic switches form an H-bridge.

15. The lighting system according to claim 10, wherein the lighting system is powered by an AC voltage source, and the DC voltage source comprises an AC/DC converter coupled to the AC voltage source.

16. The lighting system according to claim 1, wherein each said illuminating element is coupled to a respective output of the programmable controller.

17. The lighting system according to claim 1, wherein the lamp assembly comprises at least one multi-coloured lamp, each said multi-coloured lamp comprising a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the light-emitting diode pair comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element, the first and second illuminating elements being coupled to a respective output of the programmable controller.

18. A night light comprising:

a lamp assembly comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the programmable lamp controller; and

an AC/DC converter for powering the lamp assembly and the controller.

19. The night light according to claim 18, wherein each said predetermined pattern is selectable according to a user-operable input to the controller.

20. The night light according to claim 18, wherein the lamp assembly comprises at least one multi-coloured lamp coupled in parallel to a DC output of the AC/DC converter, each said multi-coloured lamp comprising a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the light-emitting diode pair comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

21. The night light according to claim 18, wherein the lamp assembly comprises at least one multi-coloured lamp coupled in parallel to a DC output of the AC/DC converter, the first illuminating element of each said multi-coloured lamp being coupled to the DC output through a first electronic switch, and the second illuminating element of each said multi-coloured lamp being coupled to the DC output through a second electronic switch, the first and second electronic switches being coupled to the programmable controller for setting the conduction angle of the multi-coloured lamps.

22. The night light according to claim 18, wherein the controller includes an ambient light sensor for inhibiting conduction of the illuminating elements when an intensity of ambient light exceeds a threshold.

23. A jewelry piece comprising:

a lamp assembly comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the programmable lamp controller;

a DC power source for powering the lamp assembly and the controller; and

a housing retaining the lamp assembly, the controller and the power source therein.

24. The jewelry piece according to claim 23, wherein each said predetermined pattern is selectable according to a user-operable input to the controller.

25. The jewelry piece according to claim 23, wherein the lamp controller includes a temperature sensor for selecting the at least one pattern.

26. The jewelry piece according to claim 23, wherein the lamp controller includes a clock circuit for selecting the at least one pattern.

27. A key chain comprising:

a lamp assembly comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the programmable lamp controller;

a DC power source for powering the lamp assembly and the controller;

a housing retaining the lamp assembly, the controller and the power source therein; and

retaining means coupled to the housing for retaining keys therein.

28. The key chain according to claim 27, wherein each said predetermined pattern is selectable according to a user-operable input to the controller.

29. The key chain according to claim 27, wherein the lamp controller includes a temperature sensor for selecting the at least one pattern.

30. The key chain according to claim 27, wherein the lamp controller includes a clock circuit for selecting the at least one pattern.

ABSTRACT

09/285 367

A variable-effect lighting system includes a lamp assembly, and a programmable lamp controller. The lamp assembly comprises a string of bicoloured lamps, each bicoloured lamp including a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light. The programmable lamp controller is coupled to the lamp assembly for setting the conduction angle of the illuminating elements according to at least one predetermined pattern stored in a memory of the lamp controller. Preferably, the controller includes a user-operable input to allow the user to select the predetermined pattern and hence the colour display as desired.

Docket No.
T8464953US

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

VARIABLE-EFFECT LIGHTING SYSTEM

the specification of which

(check one)

☒ is attached hereto.

☐ was filed on _____ as United States Application No. or PCT International Application Number _____

and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Not Claimed
(Number)	(Country)	(Day/Month/Year Filed)	☐
(Number)	(Country)	(Day/Month/Year Filed)	☐
(Number)	(Country)	(Day/Month/Year Filed)	☐

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

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VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) AND 1.27 (b)) - INDEPENDENT INVENTOR	Docket No. T8464953US

Serial No.	Filing Date	Patent No.	Issue Date

Applicant/ Patentee: **RUXTON, James**

Invention: **VARIABLE-EFFECT LIGHTING SYSTEM**

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled above and described in:

- ☒ the specification to be filed herewith.
- ☐ the application identified above.
- ☐ the patent identified above.

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☒ No such person, concern or organization exists.
- ☐ Each such person, concern or organization is listed below.

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities (37 CFR 1.27)

FULL NAME _____

ADDRESS _____

☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

FULL NAME _____

ADDRESS _____

☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

FULL NAME _____

ADDRESS _____

☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

FULL NAME _____

ADDRESS _____

☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF INVENTOR James Ruxton
SIGNATURE OF INVENTOR James Ruxton DATE: April 14/99

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PRINT OF DRAWINGS
AS ORIGINALLY FILED

315

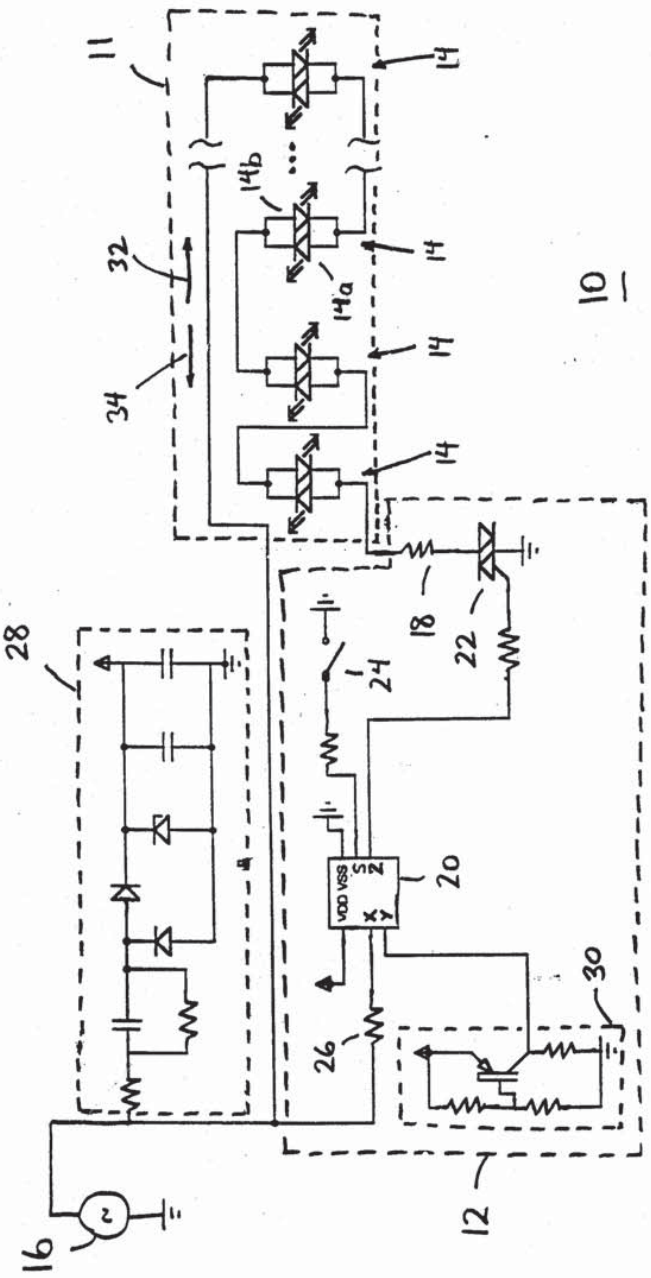

FIG. 1a

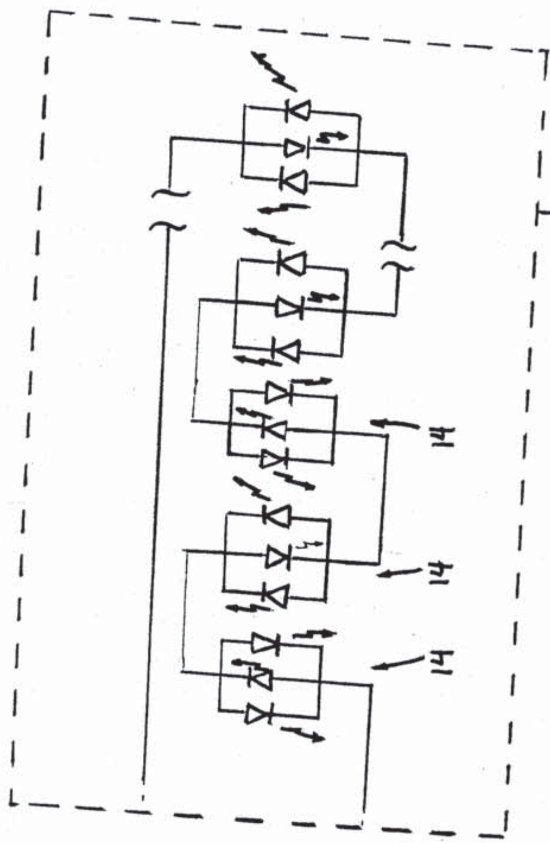

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FIG. 1b

PRINT OF DR LNGS
AS ORIGINA FILED

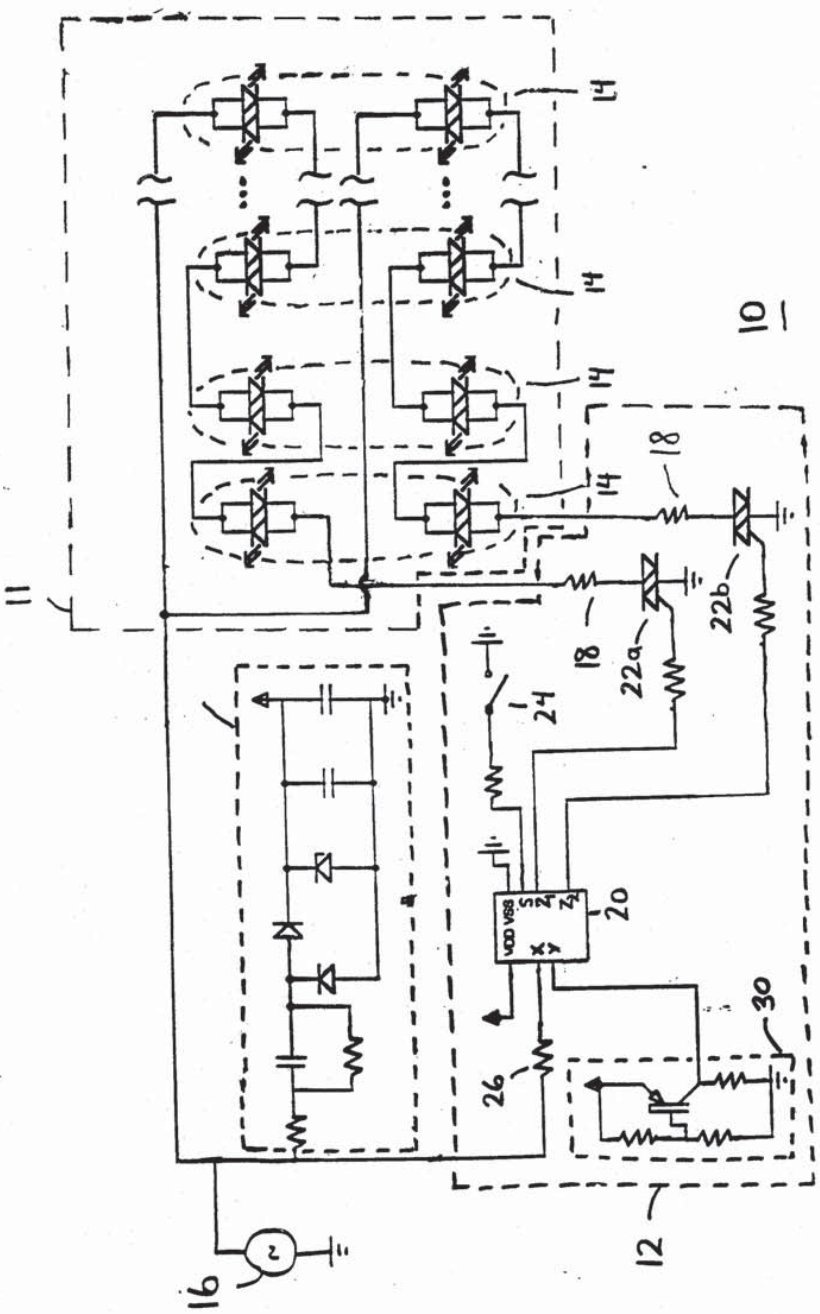

FIG. 1c

PRINT OF DR[illegible]INGS
AS ORIGINA[illegible]/ FILED

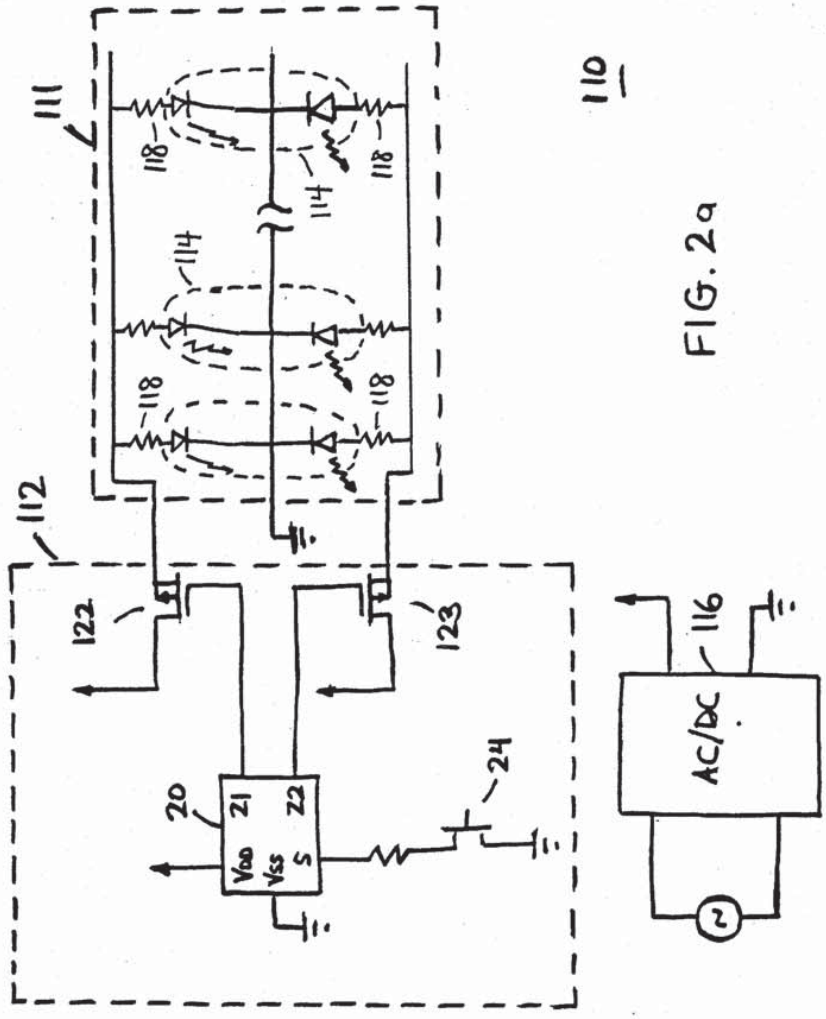

FIG. 2a

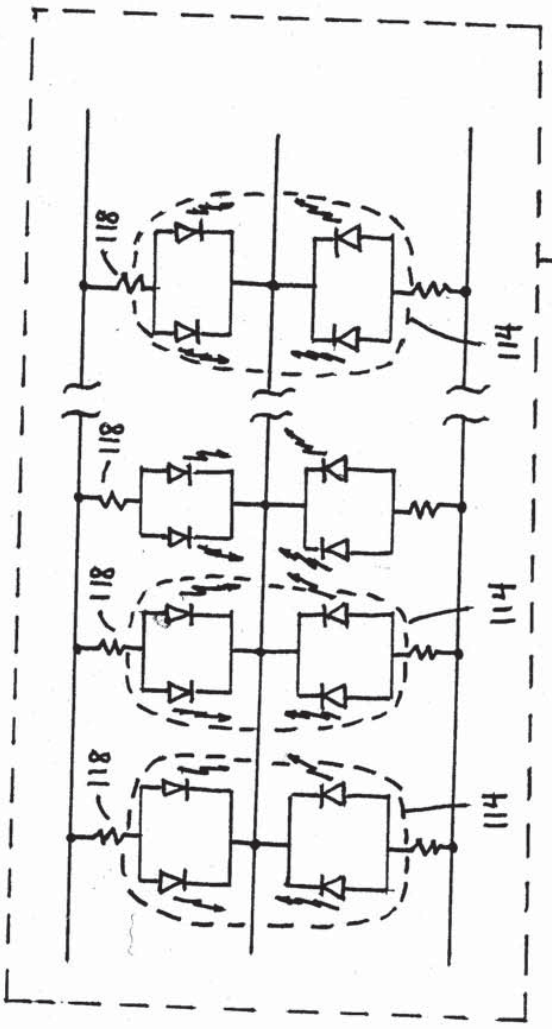

FIG. 2b

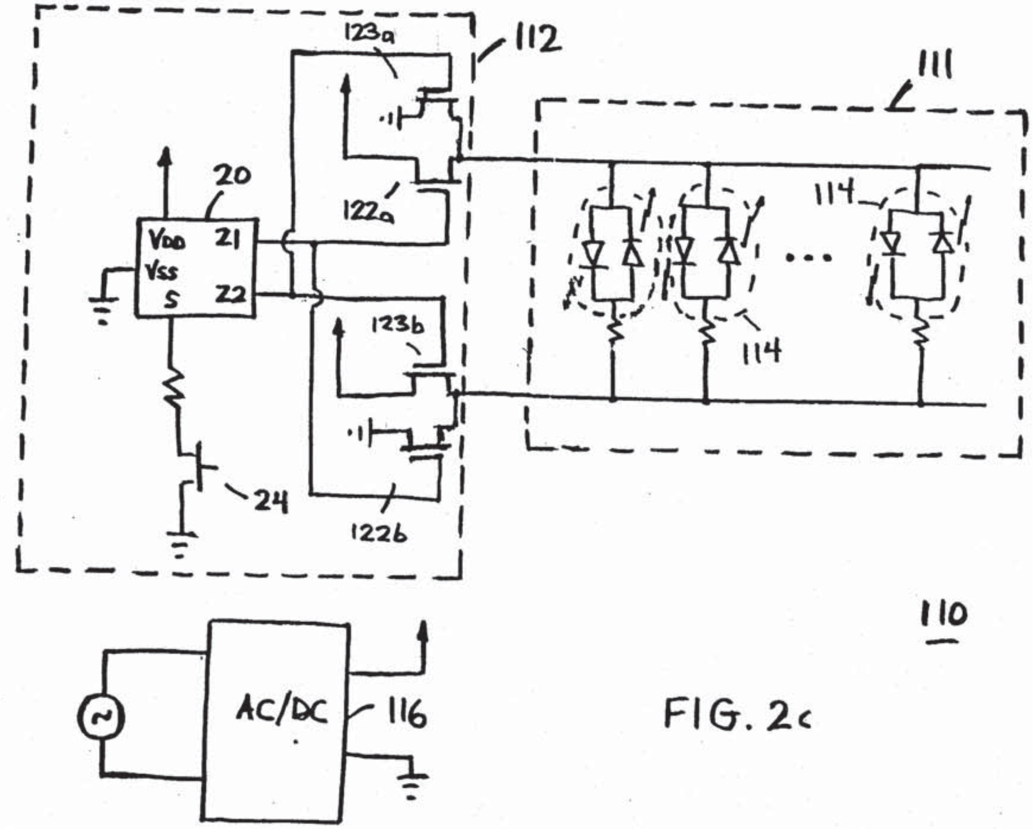

FIG. 2c

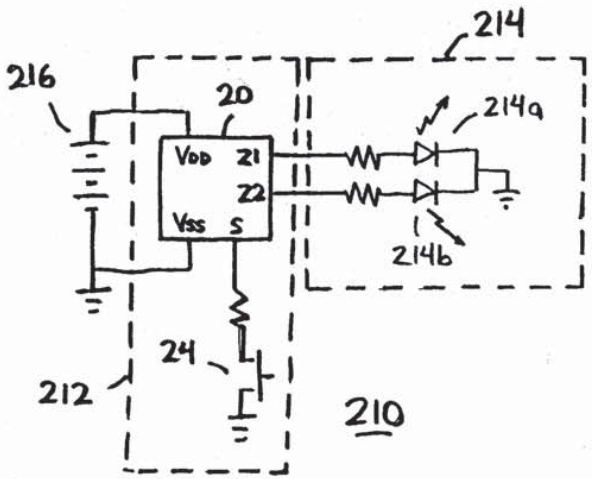

FIG. 3

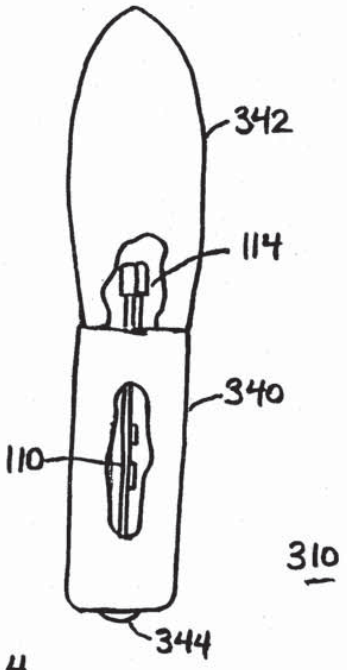

FIG. 4

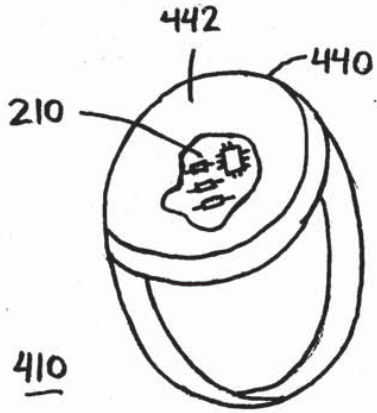

FIG. 5a

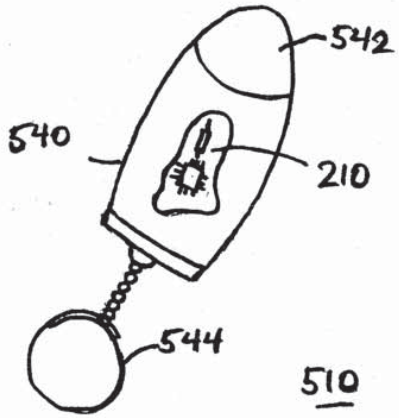

FIG. 5b

TRANSMITTAL OF INFORMATION DISCLOSURE STATEMENT (Under 37 CFR 1.97(b) or 1.97(c))	Docket No. T8464953US

In Re Application Of: **RUXTON, James**

2/IDS Sours 8-10-99

Serial No.	Filing Date	Examiner	Group Art Unit
09/295,367	04/21/99	N/A	2821

Title: **VARIABLE-EFFECT LIGHTING SYSTEM**

2821

Address to:
Assistant Commissioner for Patents
Washington, D.C. 20231

37 CFR 1.97(b)

1. ☒ The Information Disclosure Statement submitted herewith is being filed within three months of the filing of a national application; within three months of the date of entry of the national stage as set forth in 37 CFR 1.491 in an international application; or before the mailing date of a first Office Action on the merits, whichever event occurs last.

37 CFR 1.97(c)

2. ☐ The Information Disclosure Statement submitted herewith is being filed after three months of the filing of a national application, or the date of entry of the national stage as set forth in 37 CFR 1.491 in an international application; or after the mailing date of a first Office Action on the merits, whichever occurred last but before the mailing date of either:

   1. a Final Action under 37 CFR 1.113, or
   2. a Notice of Allowance under 37 CFR 1.311,

   whichever occurs first.

Also submitted herewith is:

☐ a certification as specified in 37 CFR 1.97(e);

OR

☐ the fee set forth in 37 CFR 1.17(p) for submission of an Information Disclosure Statement under 37 CFR 1.97(c).

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TRANSMITTAL OF INFORMATION DISCLOSURE STATEMENT (Under 37 CFR 1.97(b) or 1.97(c))	Docket No. T8464953US

In Re Application Of: **RUXTON, James**

Serial No.	Filing Date	Examiner	Group Art Unit
09/295,367	04/21/99	N/A	2821

Title: **VARIABLE-EFFECT LIGHTING SYSTEM**

Payment of Fee
(Only complete if Applicant elects to pay the fee set forth in 37 CFR 1.17(p))

- ☐ A check in the amount of is attached.
- ☐ The Assistant Commissioner is hereby authorized to charge and credit Deposit Account No. as described below. A duplicate copy of this sheet is enclosed.
  - ☐ Charge the amount of
  - ☐ Credit any overpayment.
  - ☐ Charge any additional fee required.

Certificate of Transmission by Facsimile*

I certify that this document and authorization to charge deposit account is being facsimile transmitted to the United States Patent and Trademark Office (Fax. No.) on (Date)

Signature

Typed or Printed Name of Person Signing Certificate

Certificate of Mailing by First Class Mail

I certify that this document and fee is being deposited on with the U.S. Postal Service as first class mail under 37 C.F.R. 1.8 and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Signature of Person Mailing Correspondence

Typed or Printed Name of Person Mailing Correspondence

***This certificate may only be used if paying by deposit account.**

Rob Graham

Signature

Dated: **August 4, 1999**

Robert J. Graham
Reg. No. 43,430

cc:

P10A/REV01

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

Docket Number (Opti	Application Number
T8464..3US	09/295,367
Applicant(s)	
RUXTON, James	
Filing Date	**Group Art Unit**
04/21/99	2821

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL	REF	DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
T.T.		2,515,236	07/18/1950	M.K. Kunins	240	3.1	
T.T.		4,317,071	02/23/1982	Murad	315	312	
T.T.		5,420,482	05/30/1995	Phares	315	292	
T.T.		5,008,595	04/16/1991	Kazar	315	178	
T.T.		5,384,519	01/24/1995	Gotoh	315	324	
T.T.		3,789,211	01/29/1974	Kramer	240	10R	
T.T.		1,809,181	06/09/1931	L.A. Ramsden	unknown	unknown	
T.T.		3,388,245	06/11/1968	D.R. Larsen	240	3.1	
T.T.		4,866,580	09/12/1989	Blackerby	362	285	
T.T.		5,749,646	05/12/1998	Brittell	362	231	
T.T.		5,752,766	05/19/1998	Bailey et al	362	250	

FOREIGN PATENT DOCUMENTS

	REF	DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	Translation YES	Translation NO

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Pages, Etc.)*

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TECHNOLOGY CENTER 2800

EXAMINER	DATE CONSIDERED
Thuy Tran	3/16/2000

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP Section 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

Docket Number (Opt	Application Number
T846[illegible]3US	09/295,367
Applicant(s) RUXTON, James	
Filing Date 04/21/99	**Group Art Unit** 2821

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL	REF	DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
TT		5,619,182	04/08/1997	Robb	340	479	—
TT		3,283,136	11/01/1966	L.R. Dinkler et al	240	10	—
TT		3,324,289	06/06/1967	A. Cirko	240	10.1	—
TT		3,435,286	03/25/1969	P.J. Kayatt	315	47	—
TT		3,379,869	04/23/1968	W.H. Dorman	240	41.3	—

FOREIGN PATENT DOCUMENTS

	REF	DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	Translation YES	Translation NO

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Pages, Etc.)*

EXAMINER	Thuy Tran	DATE CONSIDERED	3/16/2000

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP Section 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

PTO - 1449 CHECKLIST

Serial No. 09/295367

Examiner: Philogene

Date to Examiner: 8-11-99

For each considered document, both the month and year MUST be provided - no exceptions. Class and subclass data MUST either be provided or the space lined through. The Examiners name and the date the disclosure citation was considered MUST be provided at the bottom of the PTO 1449.

CHECK OFF THE FOLLOWING ITEMS AS COMPLETED

For each citation considered:

1. ☐ Initials inserted in left-hand column for each citation considered

2. ☐ Month ☐ Year - inserted in appropriate box (if unavailable, citation is incomplete - go to item 4)

3. ☐ Class ☐ Subclass - inserted in appropriate box (if unavailable, citation is still proper, but you MUST draw a line through each blank space)

For each citation not considered or incomplete:

4. ☐ Citation lined through if not considered or incomplete

At bottom of PTO 1449:

5. ☐ Examiner's name in appropriate place

6. ☐ Enter the date citations were considered in the appropriate place

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/295,367	04/21/99	RUXTON J	T8464953US

MMC2/0324

GOWLING STRATHY & HENDERSON
SUITE 4900
4900 COMMERCE COURT WEST
TORONTO ON M5L IJ3
CANADA

AIR MAIL

EXAMINER	
TRAN, T	
ART UNIT	**PAPER NUMBER**
2821	
DATE MAILED:	03/24/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

PTO-90C (Rev. 2/95) U.S. G.P.O. 1999 460-693 1- File Copy

Office Action Summary	Application No.	Applicant(s)	
	09/295,367	RUXTON, JAMES	
	Examiner	Art Unit	
	THUY V. TRAN	2821	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Status

1)☒ Responsive to communication(s) filed on *21 April 1999* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11,15-20 and 22-30* is/are rejected.

7)☒ Claim(s) *12-14 and 21* is/are objected to.

8)☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a)☐ All b)☐ Some * c)☐ None of the CERTIFIED copies of the priority documents have been:

1.☐ received.

2.☐ received in Application No. (Series Code / Serial Number) _____ .

3.☐ received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. & 119(e).

Attachment(s)

14) ☒ Notice of References Cited (PTO-892)
15) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
16) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *2* .
17) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
18) ☐ Notice of Informal Patent Application (PTO-152)
19) ☐ Other:

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities:

Page 8, line 22, change "need" to --needs--

Appropriate correction is required.

2. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

4. Claims 1-2, 4-5, 7, 9, 16, 18-19 are rejected under 35 U.S.C. 102(a) as being anticipated by Chliwnyj et al. (U.S. Patent No. 5,924,784).

As to claims 1-2, 7, 9, 18-19, Chliwnyj et al. disclose an electronic lighting device which comprises a plurality of lighting elements in a plurality of colors modulated in intensity by a control circuit or microprocessor [1] with a stored program, a field-effect transistor switch, and memory chips, and an AC/DC converter [6] (see Abstract, lines 1-18; column 6, lines 25-62; column 14, lines 12-67). Chliwnyj et al. further teach that the

conduction angle for each light colored bulb is controlled according to a desired pattern (see column 9, lines 20-67; column 10, lines 1-36).

As to claim 4, regarding a clock circuit [24], see figure 12.

As to claim 5, regarding lamps [7a, 7b, 7c, 7d, 7e] being in series with AC power source [2], see figure 1.

As to claim 16, regarding each illuminating element being coupled to a respective output of the microprocessor [1], see figure 1.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 3, 6, 8, 10-11, 15, 17, 20, 22-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chliwnyj et al. (U.S. Patent No. 5,924,784).

As to claim 3, Chliwnyj et al. disclose all of the claimed subject matter except for a temperature sensor. However, it has been well known in the art that the lamp temperature can effect the brightness of the lamp and, for that, the use of a sensor to detect the lamp temperature for an efficient and effective lamp control has been a well known practice in the electric lamp art. Therefore, to modify the lighting device of Chliwnyj et al. by adding to its controller a temperature sensor to detect the lamp

temperature and to obtain an effective lamp control is considered to be obvious to one of ordinary skill in the art.

As to claims 6, 8, 17, Chliwnyj et al. disclose all of the claimed subject matter except for each multi-color lamp being comprised of a pair of LEDs connected back-to-back. To orient the LEDs of the lighting device of Chliwnyj et al. in a style such as back-to-back to obtain a desired lighting decoration with full brightness is considered to be obvious to one of ordinary skill in the art and clearly within the preview of one of ordinary skill in the art of electric lamp.

As to claims 10-11,15, 20, Chliwnyj et al. disclose all of the claimed subject matter except for at least one lamp connected in parallel to a DC power source. It would have been obvious to one of ordinary skill in the art at the time of the invention to configure a DC power supply parallel to the lamp of the lighting device of Chliwnyj et al. to protect the lamp from an electric power outage and to maintain a continuous lighting service.

As to claim 22, Chliwnyj et al. disclose all of the claimed subject matter except for a sensor to detect ambient light intensity. To modify the lighting device of Chliwnyj et al. by adding to its controller a sensor to detect ambient light for light conducting inhibition is considered to be obvious to one of ordinary skill in the art since the use of an ambient light sensor for this purpose has been a well known practice in the art of electric lamp.

As to claims 23-24, 26-28, 30, Chliwnyj et al. disclose all of the claimed subject matter except for (1) a housing to enclose the lamp assembly, the controller, and the power source, and (2) a retaining means coupled to the housing to hold the key. To modify the lighting device of Chliwnyj et al. by providing a housing to enclose all the lamps, the controller, and the power source to protect the device from environmental effect is considered to be obvious to one of ordinary skill in the art and clearly within the preview of one of ordinary skill in the art. In addition, to provide a means coupled to the housing to retain the key for convenience is obviously within the preview of an ordinary skilled artesian.

As to claims 25 and 29, Chliwnyj et al. disclose all of the claimed subject matter except for a temperature sensor. However, it has been well known in the art that the lamp temperature can effect the brightness of the lamp and, for that, the use of a sensor to detect the lamp temperature for an efficient and effective lamp control has been a well known practice in the electric lamp art. Therefore, to modify the lighting device of Chliwnyj et al. by adding to its controller a temperature sensor to detect the lamp temperature and to obtain an effective lamp control is considered to be obvious to one of ordinary skill in the art.

Claim Objections, Allowable subject matter

7. Claims 12-14, 21 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Prior art Chliwnyj et al. (U.S. Patent No. 5,924,784) disclose an electronic lighting device but lack (1) the first illuminating element or the anode of each LED of each lamp being coupled to the DC source through the first electronic switch, (2) the second illuminating element or the anode of each LED of each lamp being coupled to the DC source through the second electronic switch, and (3) both the switches being coupled to the controller for setting the conduction angle of the lamps.

Prior art Gray et al. (U.S. Patent No. 5,629,587) disclose a programmable lighting control but lack (1) the first illuminating element or the anode of each LED of each lamp being coupled to the DC source through the first electronic switch, (2) the second illuminating element or the anode of each LED of each lamp being coupled to the DC source through the second electronic switch, and (3) both the switches being coupled to the controller for setting the conduction angle of the lamps.

Inquiry

Any inquiry concerning this communication or earlier communications from the examiner should be directed to THUY V. TRAN whose telephone number is (703)305-0012. The examiner can normally be reached on M-F (8:30-6:00) First Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, DON K. WONG can be reached on (703)308-4856. The fax phone numbers for the organization where this application or proceeding is assigned are (703)308-7382 for regular communications and (703)308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)306-3431.

T. Tran
March 17, 2000

Don Wong
Supervisory Patent Examiner
Technology Center 2800

Notice of References Cited

Application/Control No.	Applicant(s)/Patent Under Reexamination	
09/295,367	RUXTON, JAMES	
Examiner	**Art Unit**	Page 1 of 1
THUY V. TRAN	2821	

U.S. PATENT DOCUMENTS

*		DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS	DOCUMENT SOURCE ** APS	OTHER
☐	A	5,629,587	May. 1997	Gray et al.	315	314	☐	☒
☐	B	5,924,784	Jul. 1999	Chliwnyj et al.	362	234	☐	☒
☐	C						☐	☐
☐	D						☐	☐
☐	E						☐	☐
☐	F						☐	☐
☐	G						☐	☐
☐	H						☐	☐
☐	I						☐	☐
☐	J						☐	☐
☐	K						☐	☐
☐	L						☐	☐
☐	M						☐	☐

FOREIGN PATENT DOCUMENTS

*		DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUBCLASS	DOCUMENT SOURCE ** APS	OTHER
☐	N							☐	☐
☐	O							☐	☐
☐	P							☐	☐
☐	Q							☐	☐
☐	R							☐	☐
☐	S							☐	☐
☐	T							☐	☐

NON-PATENT DOCUMENTS

*		DOCUMENT (Including Author, Title Date, Source, and Pertinent Pages)	DOCUMENT SOURCE ** APS	OTHER
☐	U		☐	☐
☐	V		☐	☐
☐	W		☐	☐
☐	X		☐	☐

*A copy of this reference is not being furnished with this Office action. (See Manual of Patent Examining Procedure, Section 707.05(a).)
**APS encompasses any electronic search i.e. text, image, and Commercial Databases.

Form PTO 948 (Rev. 8-98) U.S. DEPARTMENT OF COMMERCE - Patent and Trademark Office Application No. 9/295367

NOTICE OF DRAFTSPERSON'S PATENT DRAWING REVIEW

The drawing(s) filed (insert date) 4/21/99 are:

A. ☐ approved by the Draftsperson under 37 CFR 1.84 or 1.152.

B. ☒ objected to by the Draftsperson under 37 CFR 1.84 or 1.152 for the reasons indicated below. The Examiner will require submission of new, corrected drawings when necessary. Corrected drawing must be sumitted according to the instructions on the back of this notice.

1. DRAWINGS. 37 CFR 1.84(a): Acceptable categories of drawings:
   Black ink. Color.
   ____ Color drawings are not acceptable until petiton is granted. Fig(s) _____
   ____ Pencil and non black ink not permitted. Fig(s) _____
2. PHOTOGRAPHS. 37 CFR 1.84 (b)
   ____ 1 full-tone set is required. Fig(s) _____
   ____ Photographs not properly mounted (must use brystol board or photographic double-weight paper). Fig(s) _____
   ____ Foor quality (half-tone). Fig(s) _____
3. TYPE OF PAPER. 37 CFR 1.84(e)
   ____ Paper not flexible, strong, white, and durable. Fig(s) _____
   ____ Erasures, alterations, overwritings, interlineations, folds, copy machine marks not accepted. Fig(s) _____
   ____ Mylar, velum paper is not acceptable (too thin). Fig(s) _____
4. SIZE OF PAPER. 37 CFR 1.84(f): Acceptable sizes:
   ____ 21.0 cm by 29.7 cm (DIN size A4)
   ____ 21.6 cm by 27.9 cm (8 1/2 x 11 inches)
   ____ All drawing sheets not the same size. Sheet(s) _____
   ____ Drawings sheets not an acceptable size. Fig(s) _____
5. MARGINS. 37 CFR 1.84(g): Acceptable margins:
   Top 2.5 cm Left 2.5cm Right 1.5 cm Bottom 1.0 cm
   SIZE: A4 Size
   Top 2.5 cm Left 2.5 cm Right 1.5 cm Bottom 1.0 cm
   SIZE: 8 1/2 x 11
   Margins not acceptable. Fig(s) _____
   _____ Top (T) _____ Left (L)
   _____ Right (R) _____ Bottom (B)
6. VIEWS. 37 CFR 1.84(h)
   REMINDER: Specification may require revision to correspond to drawing changes.
   Partial views. 37 CFR 1.84(h)(2)
   ____ Brackets needed to show figure as one entity. Fig(s) _____
   ____ Views not labeled separately or properly. Fig(s) _____
   ____ Enlarged view not labeled separetely or properly. Fig(s) _____
7. SECTIONAL VIEWS. 37 CFR 1.84 (h)(3)
   ____ Hatching not indicated for sectional portions of an object. Fig(s) _____
   ____ Sectional designation should be noted with Arabic or Roman numbers. Fig(s) _____
8. ARRANGEMENT OF VIEWS. 37 CFR 1.84(i)
   ____ Words do not appear on a horizontal, left-to-right fashion when page is either upright or turned so that the top becomes the right side, except for graphs. Fig(s) _____
9. SCALE. 37 CFR 1.84(k)
   ____ Scale not large enough to show mechanism without crowding when drawing is reduced in size to two-thirds in reproduction. Fig(s) _____
10. CHARACTER OF LINES, NUMBERS, & LETTERS. 37 CFR 1.84(i)
    ____ Lines, numbers & letters not uniformly thick and well defined, clean, durable, and black (poor line quality). Fig(s) 1-5B
11. SHADING. 37 CFR 1.84(m)
    ____ Solid black areas pale. Fig(s) _____
    ____ Solid black shading not permitted. Fig(s) _____
    ____ Shade lines, pale, rough and blurred. Fig(s) _____
12. NUMBERS, LETTERS, & REFERENCE CHARACTERS. 37 CFR 1.84(p)
    ____ Numbers and reference characters not plain and legible. Fig(s) 1-5B
    ____ Figure legends are poor. Fig(s) _____
    ____ Numbers and reference characters not oriented in the same direction as the view. 37 CFR 1.84(p)(1) Fig(s) _____
    ____ English alphabet not used. 37 CFR 1.84(p)(2) Figs _____
    ____ Numbers, letters and reference characters must be at least .32 cm (1/8 inch) in height. 37 CFR 1.84(p)(3) Fig(s) _____
13. LEAD LINES. 37 CFR 1.84(q)
    ____ Lead lines cross each other. Fig(s) _____
    ____ Lead lines missing. Fig(s) _____
14. NUMBERING OF SHEETS OF DRAWINGS. 37 CFR 1.84(t)
    ____ Sheets not numbered consecutively, and in Arabic numerals beginning with number 1. Sheet(s) _____
15. NUMBERING OF VIEWS. 37 CFR 1.84(u)
    ____ Views not numbered consecutively, and in Arabic numerals, beginning with number 1. Fig(s) _____
16. CORRECTIONS. 37 CFR 1.84(w)
    ____ Corrections not made from prior PTO-948 dated _____
17. DESIGN DRAWINGS. 37 CFR 1.152
    ____ Surface shading shown not appropriate. Fig(s) _____
    ____ Solid black shading not used for color contrast. Fig(s) _____

COMMENTS

REVIEWER WAS DATE 5/19/99 TELEPHONE NO. 7033058404

ATTACHMENT TO PAPER NO. 3

INFORMATION ON HOW TO EFFECT DRAWING CHANGES

1. Correction of Informalities--37 CFR 1.85

File new drawings with the changes incorporated therein. The application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application, should be placed on the back of each sheet of drawings in accordance with 37 CFR 1.84(c). Applicant may delay filing of the new drawings until receipt of the Notice of Allowability (PTOL-37). Extensions of time may be obtained under the provisions of 37 CFR 1.136. The drawing should be filed as a separate paper with a transmittal letter addressed to the Drawing Processing Branch.

2. Timing for Corrections

Applicant is required to submit **acceptable** corrected drawings within the three-month shortened statutory period set in the Notice of Allowability (PTOL-37). If a correction is determined to be unacceptable by the Office, applicant must arrange to have acceptable corrections resubmitted within the original three-month period to avoid the necessity of obtaining an extension of time and paying the extension fee. Therefore, applicant should file corrected drawings as soon a possible.

Failure to take corrective action within set (or extended) period will result in **ABANDONMENT** of the Application.

3. Corrections other than Informalities Noted by the Drawing Review Branch on the Form PTO-948

All changes to the drawings, other than informalities noted by the Drawing Review Branch, **MUST** be approved by the examiner before the application will be allowed. No changes will be permitted to be made, other than correction of informalities, unless the examiner has approved the proposed changes.

	Type	L #	Hits	Search Text	DBs	Time Stamp	Comments	Error Definition	Errors
2	BRS	L2	0	1 and controll$3 and (conduct$3 adj angle)	USPAT	2000/03/16 17:11			0
3	BRS	L3	1191	(conduct$3 adj angle)	USPAT	2000/03/16 17:19			0
4	BRS	L4	195	3 and control$4 and memory	USPAT	2000/03/16 17:21			0
5	BRS	L5	118	4 and light$3	USPAT	2000/03/16 17:22			0
6	BRS	L6	81	5 and program$5	USPAT	2000/03/16 17:24			0
7	BRS	L7	0	1 and 6	USPAT	2000/03/16 17:24			0
8	BRS	L9	14	6 and color$	USPAT	2000/03/16 17:27			0

	Type	L #	Hits	Search Text	DBs	Time Stamp	Comments	Error Definition	Errors
1	BRS	L1	314	light$3 and (illuminat$3 adj element$) and color$	USPAT	2000/03/16 17:24		TruncationOverflow.Returnstri	1

	Document ID	Issue Date	Pages	Title	Current OR	Current XRef
1	US 5977694 A	19991102	37	Apertured daylight lamp	313/110	313/112 ; 313/113 ; 362/293 ; 362/361
2	US 5924784 A	19990720	43	Microprocessor based simulated electronic flame	362/234	307/64 ; 315/324 ; 315/86 ; 362/154 ; 362/184 ; 362/253 ; 52/128 ; 52/133
3	US 5672941 A	19970930	36	Inductorless controlled transition light dimmers optimizing output waveforms	315/194	315/199 ; 315/291 ; 315/317 ; 323/235 ; 323/242
4	US 5666017 A	19970909	35	Daylight lamp	313/110	313/112 ; 313/113 ; 313/116 ; 315/297
5	US 5640231 A	19970617	48	Image forming apparatus and temperature control device for fixing unit for use therewith	399/335	219/216
6	US 5629587 A	19970513	26	Programmable lighting control system for controlling illumination duration and intensity levels of lamps in multiple lighting strings	315/292	315/293 ; 315/294 ; 315/314
7	US 5569983 A	19961029	27	Electronic apparatus for producing variable spectral output	315/297	315/294 ; 315/307 ; 315/314

	Document ID	Issue Date	Pages	Title	Current OR	Current XRef
8	US 5455490 A	19951003	35	Power and signal distribution in lighting systems	315/194	315/199 ; 323/235 ; 323/242 ; 327/451
9	US 5225765 A	19930706	38	Inductorless controlled transition and other light dimmers	323/235	315/194 ; 323/242 ; 327/451
10	US 5066896 A	19911119	12	Electric lighting and power controllers therefor	315/291	315/194 ; 315/292 ; 315/294 ; 315/307
11	US 4975629 A	19901204	39	Inductorless controlled transition and other light dimmers	323/235	315/194 ; 323/242 ; 327/451
12	US 4534642 A	19850813	60	Electrophotographic copying apparatus for effecting a copying operation on the basis of a set copying characteristic	399/138	
13	US 4421610 A	19831220	9	Electrolytic coloring process	205/175	204/DIG.9 ; 205/324 ; 205/328 ; 205/917
14	US 4299481 A	19811110	6	Adjustable current lamphouse	355/69	355/70

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/295,367	04/21/99	RUXTON J	T8464953US

MMC1/1101

GOWLING STRATHY & HENDERSON
SUITE 4900
4900 COMMERCE COURT WEST
TORONTO ON M5L 1J3
CANADA

AIR MAIL

EXAMINER	
TRAN, T	
ART UNIT	**PAPER NUMBER**
2821	

DATE MAILED: 11/01/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

PTO-90C (Rev. 2/95) U.S. G.P.O. 1999 460-693 1- File Copy

Notice of Abandonment	Application No.	Applicant(s)	
	09/295,367	RUXTON, JAMES	
	Examiner	Art Unit	
	THUY V. TRAN	2821	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

This application is abandoned in view of:

1. ☒ Applicant's failure to timely file a proper reply to the Office letter mailed on *24 March 2000*.
   (a) ☐ A reply was received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the period for reply (including a total extension of time of _____ month(s)) which expired on _____.
   (b) ☐ A proposed reply was received on _____, but it does not constitute a proper reply under 37 CRF 1.113 (a) to the final rejection.
   (A proper reply under 37 CRF 1.113 to a final rejection consists only of: (1) a timely filed amendment which places the application in condition for allowance; or (2) a timely filed Notice of Appeal (with appeal fee)).
   (c) ☒ No reply has been received.

2. ☐ Applicant's failure to timely pay the required issue fee within the statutory period of three months from the mailing date of the Notice of Allowance (PTO-85).
   (a) ☐ The issue fee was received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the statutory period for payment of the issue fee set in the Notice of Allowance.
   (b) ☐ The submitted issue fee of $_____ is insufficient. The issue fee required by 37 CFR 1.18 is $_____.
   (c) ☐ The issue fee has not been received.

3. ☐ Applicant's failure to timely file new formal drawings as required in the Notice of Allowability (PTO-37).
   (a) ☐ Proposed new formal drawings were received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the period for reply (including a total extension of time of _____ month(s)), which expired on _____.
   (b) ☐ The proposed new formal drawings filed _____ are not acceptable.
   (c) ☐ No proposed new formal drawings have been received.

4. ☐ The letter of express abandonment which is signed by the attorney or agent of record, the assignee of the entire interest, or all of the applicants.

5. ☐ The letter of express abandonment which is signed by an attorney or agent (acting in a representative capacity under 37 CFR 1.34(a)) upon the filing of a continuing application.

6. ☐ The decision by the Board of Patent Appeals and Interference rendered on _____ and because the period for seeking court review of the decision has expired and there are no allowed claims.

7. ☒ The reason(s) below:

A confirmation was made on 10/25/2000 with Mr. Robert J. Graham, the Applicant's attorney, regarding the abandonment status of the instant application.

Don Wong
Supervisory Patent Examiner
Technology Center 2800

9200 TC 2803

#5

Petition For Revival Of An Application For Patent Abandoned Unintentionally Under 37 CFR 1.137(b), 37 CFR 1.155(c) or 37 CFR 1.316(c)	Docket No. T8464953US

In Re Application Of: **RUXTON, James**

Serial No.	Filing Date	Examiner	Group Art Unit
09/295,367	April 21, 1999	[illegible]	2821

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NOV 14 2000
TECHNOLOGY CENTER 2800
SPECIAL PROGRAM CENTER

Invention:
VARIABLE-EFFECT LIGHTING SYSTEM

RECEIVED
OCT 25 2000
TECHNOLOGY CENTER 2800

ASSISTANT COMMISSIONER FOR PATENTS
Attention: Office of Petitions
Box DAC
Washington, D.C. 20231

NOTE: If information or assistance is needed in completing this form, please contact Petitions Information at (703) 305-9282.

The above-identified application became abandoned for failure to file a timely and proper response to a notice or action by the Patent and Trademark Office. The date of abandonment is the day after the expiration date of the period set for reply in the Office notice or action plus any extension of time actually obtained.

APPLICANT HEREBY PETITIONS FOR REVIVAL OF THIS APPLICATION

NOTE: A grantable petition requires the following items:
(1) Petition fee;
(2) Reply and/or issue fee;
(3) Terminal disclaimer with disclaimer fee--required for all utility and plant applications filed before June 8, 1995; and
(4) Statement that the entire delay was unintentional.

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DEC 0 1 2000
OFFICE OF PETITIONS

1. ☒ A proposed response to the above-identified Office Action:
   ☒ is enclosed.
   ☐ was filed on _____
   The proposed response is in the form of: **Amendment**

2. ☒ A small entity declaration:
   ☐ is enclosed.
   ☒ was filed on **April 21, 1999**

3. ☒ The abandoned application was a:
   ☐ design application. ☒ utility application. ☐ plant application.

4. ☐ A terminal disclaimer (and fee) disclaiming a period equivalent to the period of abandonment is enclosed.

5. ☒ Since this utility/plant application was filed on or after June 8, 1995, no terminal disclaimer is required.

02/13/2001 LGEBRE 00000008 09295367
01 FC:246 0.00 CH 071750

Petition For Revival Of An Application For Patent Abandoned Unintentionally Under 37 CFR 1.137(b), 37 CFR 1.155(c) or 37 CFR 1.316(c)	Docket No. T8464953US

In Re Application Of: **RUXTON, James**

Serial No.	Filing Date	Examiner	Group Art Unit
09/295,367	April 21, 1999	Tran, Thuy V.	2821

Invention:

VARIABLE-EFFECT LIGHTING SYSTEM

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Calculation and Payment of Fees

Enclosed are the following fees:

6. ☒ Petition fee under 37 CFR 1.17(m) in the amount of: **$605.00**
7. ☐ Fee for amendment in the amount of:
8. ☐ Fee for extension of time to respond to Office Action in the amount of:
9. ☐ Issue fee in the amount of:
10. ☐ Continuing application filing fee in the amount of:
11. ☐ Terminal disclaimer fee in the amount of:
12. ☐ _____

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DEC 0 1 2000
OFFICE OF PETITIONS

Total fees enclosed: **$605.00**

The fee of **$605** is to be paid as follows:

☐ A check in the amount of the fee is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account No. **07-1750**

A duplicate copy of this sheet is enclosed.

Petition For Revival Of An Application For Patent Abandoned Unintentionally Under 37 CFR 1.137(b), 37 CFR 1.155(c) or 37 CFR 1.316(c)	Docket No. T8464953US

In Re Application Of: **RUXTON, James**

Serial No.	Filing Date	Examiner	Group Art Unit
09/295,367	April 21, 1999	Tran, Thuy V.	2821

Invention:

VARIABLE-EFFECT LIGHTING SYSTEM

Statement

The entire delay in filing the required reply from the due date for the required reply until the filing of a grantable petition under 37 CFR 1.137(b) was unintentional.

Rob Graham 43,436
Signature

Dated: 23 October 2000

I certify that this document and fee is being deposited on with the U.S. Postal Service as first class mail under 37 C.F.R. 1.8 and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Signature of Person Mailing Correspondence

Typed or Printed Name of Person Mailing Correspondence

cc:

#6

IN THE UNITED STATES PATENT AND TRADEMARKS OFFICE

In re Application of:
RUXTON, James

Serial No.: 09/295,367
Filed: April 21, 1999
Title: Variable-Effect Lighting System

Our Docket: T8464953US

Examiner: Tran, Thuy V.
Tel: (703) 305-0012 Fax: (703) 308-7722

Art Unit: 2821

To: The Commissioner of Patents and Trade-Marks
Washington, D.C. 20231
U.S.A.

23 October 2000

Dear Sir:

This communication is filed in response to the Office Action mailed March 24, 2000 as Paper Number 3, a response to which was due June 24, 2000; and is accompanied by a Petition for Revival of an Application for Patent Abandoned Unintentionally Under 37 CFR 1.137(b).

Please amend this application as follows:

--AMENDMENTS--

IN THE DESCRIPTION

Please amend the description of the preferred embodiment of the invention as follows:

at page 8, line 22, replace "the microcontroller 20 need only be programmed" with –the microcontroller 20 needs only to be programmed–.

IN THE CLAIMS

Please cancel claims 4, 5, 7 to 10, 12, 13, 15 to 17, and 21, without prejudice, and replace claims 1, 6, 11, 14, 18, 20, 23, 26, 27, and 30, respectively with amended claims 1, 6, 11, 14, 18, 20, 23, 26, 27, and 30, as set out below:

1. [Amended] A variable-effect lighting system comprising:

a lamp assembly comprising a plurality of multi-coloured lamps in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour; and

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element.

4. [Deleted]

5. [Deleted]

6. [Amended] The lighting system according to claim [5] 31, wherein each said multi-coloured lamp comprises a pair of light-emitting diodes connected back-to-back, a first light-emitting diode of the light-emitting diode comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

7. [Deleted]

8. [Deleted]

9. [Deleted]

10. [Deleted]

11. [Amended] The lighting system according to claim [10] 1, wherein each said multi-coloured lamp comprises a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the light-emitting diode comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

12. [Deleted]

13. [Deleted]

14. [Amended] The lighting system according to claim [13] 11, wherein the first and second electronic switches form an H-bridge.

15. [Deleted]

16. [Deleted]

17. [Deleted]

18. [Amended] A night light comprising:

a lamp assembly comprising at least one multi-coloured lamp in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said

predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element; and

an AC/DC converter [for powering the lamp assembly and the controller] providing the DC voltage source.

20. [Amended] The night light according to claim 18, wherein [the lamp assembly comprises at least one multi-coloured lamp coupled in parallel to a DC output of the AC/DC converter, each said multi-coloured lamp comprising] each said multi-coloured lamp comprises a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the light-emitting diode comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

21. [Deleted]

23. [Amended] A jewelry piece comprising:

a lamp assembly comprising at least one multi-coloured lamp in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element; and

a DC power source for powering the lamp assembly and the controller[; and

a housing retaining the lamp assembly, the controller and the power source therein].

26. [Amended] The jewelry piece according to claim 23, wherein [the lamp controller includes a clock circuit for selecting the at least one pattern] each said multi-coloured lamp comprises a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the light-emitting diode comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

27. [Amended] A key chain comprising:

a lamp assembly comprising at least one multi-coloured lamp in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element;

a DC power source for powering the lamp assembly and the controller;

a housing retaining the lamp assembly, the controller and the power source therein; and

retaining means coupled to the housing for retaining keys therein.

30. [Amended] The key chain according to claim 27, wherein [the lamp controller includes a clock circuit for selecting the at least one pattern] each said multi-coloured lamp comprises a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the light-emitting diode comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

Please also add new claims 31, 32 and 33 as follows:

31. [New] A variable-effect lighting system comprising:

a lamp assembly comprising a plurality of multi-coloured lamps in series with an AC voltage source and in series with each other, the AC voltage source having a first voltage phase and a second voltage phase opposite the first phase, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light during the first voltage phase, and a second illuminating element for producing a second colour of light different from the first colour during the second voltage phase; and

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller.

32. [New] The lighting system according to claim 31, wherein the at least one pattern is selectable according to a user-operable input to the controller.

33. [New] The lighting system according to claim 31, wherein the lamp controller includes an ambient temperature sensor for selecting the at least one pattern.

--REMARKS--

Claims 1 to 30 are presently pending in the subject patent application, and stand rejected under 35 USC 102(a) and 35 USC 103(a) for being unpatentable in view of the prior art. In particular, claims 1, 2, 4, 5, 7, 9, 16, 18 and 19 were rejected for being anticipated by Chliwnyj (US 5,924,784); claims 3, 6, 8, 10, 11, 15, 17, 20, 22 to 30 were rejected for being obvious in view of Chliwnyj. Claims 12, 13, 14, 21 were objected to for depending upon a rejected base claim.

In response to the Office Action, the Applicant cancelled claims 4, 5, 7 to 10, 12, 13, 15 to 17, and 21; and amended claims 1, 6, 11, 14, 18, 20, 23, 26, 27, and 30, and added new claims 31 to 33, as set out above. The Applicant submits that the invention, as now defined in claims 1 to 3, 6, 11, 14, 18 to 20, and 22 to 33, patentably distinguishes over the cited prior art. The basis of the Applicant's position will be explained more fully in the following paragraphs.

Rejection of Claims 1 to 17

Independent claim 1 of the subject patent application relates to a variable-effect lighting system. The claimed lighting system, as amended herein, comprises:

a lamp assembly comprising a plurality of multi-coloured lamps in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour; and

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating elements and a second electronic switch coupled to the second illuminating elements.

The Examiner will note that the limitations of claim 12 (objected to only for being dependent upon a rejected base claim) have been substantially incorporated into amended claim 1. A distinguishing feature of the invention, as recited in amended claim 1, is that the lamp assembly comprises a number of multi-coloured lamps in parallel with a DC voltage source, with each multi-coloured lamp including a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour, and that the lamp controller includes a first electronic switch coupled to all of the first illuminating elements and a second electronic switch coupled to all of the second illuminating elements. In this manner, the lamp controller is able to control the conduction angle of each illuminating element and thereby control the illumination effects produced by a number of multi-coloured lamps. None of the prior art references cited by the Examiner or provided by the Applicant, either alone or in combination, teach or suggest an invention including this arrangement.

Chliwnyj (US 5,924,784)

Chliwnyj teaches a microprocessor-based electronic lighting device that simulates an electronic flame. As the patentee discloses at column 5, lines 11 to column 8, line 65 of the patent, the lighting device comprises a microprocessor having a number of pulse-width modulation (PWM) outputs, and a number of uni-colour LEDs each emitting one of two or three different colours, with each LED being connected between a common DC voltage source and a respective one of the PWM outputs. Preferably, the LEDs are housed in a common fixture, such as the fixtures shown in Figs. 3, 4 and 5. The microprocessor indexes a table of sinewave amplitude values to generate independent periodic waveforms for each LED. The microprocessor is programmed to independently vary the frequency of each waveform and to independently change from one frequency to another so as to provide a number of different illumination effects. The lighting device also includes a pseudo-random number generator for pseudo-randomly varying the illumination effects. In one variation, discussed at column 10, lines 5 to 18 of the patent, the lighting device uses white incandescent light bulbs, and a triac for controlling the conduction angle of the light bulbs. In yet another variation, disclosed at column 13, lines 35 to 64 of the patent, the lighting device includes a number of LEDs arranged in a series-parallel configuration for increased light intensity.

As will be apparent from the foregoing, Chliwnyj does not teach a lighting system comprising (1) a lamp assembly including a plurality of multi-coloured lamps in parallel with a DC voltage source, with each multi-coloured lamp having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour; and (2) a lamp controller including a first electronic switch coupled to the first illuminating elements and a second electronic switch coupled to the second illuminating elements, as recited in amended claim 1 of the subject patent application. Instead, Chliwnyj only teaches a lighting device comprising separate and distinct uni-coloured lamps, and a number of control ports (eg. microprocessor PWM outputs or triacs) each being connected to and controlling only a single one of the lamps. Consequently, the invention recited in amended claim 1 of the subject patent application is not anticipated by Chliwnyj.

Gray (US 5,629,587)

Gray teaches a programmable lighting control system for decorative and artistic lighting applications. As the patentee discloses at column 4, line 53 to column 6, line 60 of the patent, the lighting control system comprises a number of independent AC receptacles for receiving strings of series- or parallel-connected lights, and controller electronics for controlling the receptacles. The controller electronics comprises a microprocessor, a memory storing program instructions for the microprocessor, a number of AC switches controlled by the microprocessor for independently controlling the timing and intensity of light emitted by the lights, a serial interface for downloading program instructions into the memory, a rotary switch for selecting either a pre-programmed or user-defined lighting sequence, and a zero-crossing detector which outputs a pulse to the microprocessor in synchronism with each zero-crossing of the AC power line. As the patentee discloses at column 7, lines 40 to 56 of the patent, the zero-crossing detector is used by the microprocessor to divide each half cycle of the input power AC waveform into a number of time slots. For each time slot, the microprocessor reads from a table the active power level for the time slot, and turns on the AC receptacles whose desired power level (as required by the selected lighting sequence) matches the active power level.

As will be apparent from the foregoing, Gray does not teach a lighting system comprising (1) a lamp assembly including a plurality of multi-coloured lamps in parallel with a DC voltage source, with each multi-coloured lamp having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour; and (2) a lamp controller including a first electronic switch coupled to the first illuminating elements and a second electronic switch coupled to the second illuminating elements, as recited in amended claim 1 of the subject patent application. Instead, Gray only teaches a lighting device comprising separate strings of lights in series with an AC voltage source, and a number of AC switches each being connected to and controlling only a single string of the lights. Consequently, the invention recited in amended claim 1 of the subject patent application is not anticipated by Gray.

The Applicant also submits that the invention recited in amended claim 1 of the subject patent application is not obvious in light of Chliwnyj and Gray. The Applicant puts forth three bases for this submission. The initial basis of the Applicant's position is that for a *prima facie* obviousness rejection to be raised in view of a modification to a prior art reference, there must be some suggestion in the prior art for the modification. However, as the Applicant will explain below, the requisite suggestion is lacking.

As discussed above, amended claim 1 relates to a lighting system comprising a lamp assembly which includes (1) a number of multi-coloured lamps in parallel with a DC voltage source, with each multi-coloured lamp having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour, and (2) a lamp controller including a first electronic switch coupled to the first illuminating elements and a second electronic switch coupled to the second illuminating elements. Although Chliwnyj also teaches an electronic lighting device which includes a number of lamps in parallel with a DC voltage source, and a controller for controlling the conduction interval of the lamps, Chliwnyj fails to disclose or suggest the use of multi-coloured lamps, with each multi-coloured lamp having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour. Further Chliwnyj also fails to disclose or suggest the use of a lamp controller which includes a first electronic switch coupled to all of the first illuminating elements and a second electronic switch coupled to all of the second illuminating elements.

Similarly, Gray teaches an electronic lighting device which includes a number of lamps, and a controller for controlling the lamps. However, Gray fails to disclose or suggest the use of multi-coloured lamps, with each multi-coloured lamp having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour. Further Gray also fails to disclose or suggest the use of a DC voltage source for powering the lamps, or a lamp controller which includes a first electronic switch coupled to all of the first illuminating elements and a second electronic switch coupled to

all of the second illuminating elements. Accordingly, as none of the references located by the Examiner or provided by the Applicant disclose a lighting system including these features, the requisite suggestion in the prior art for the modification of Chliwnyj is lacking.

The second basis of the Applicant's position that the invention recited in amended claim 1 of the subject patent application is not obvious in view of Chliwnyj and Gray is that for a *prima facie* obviousness rejection to be raised in view of a modification to a prior art reference, not only must there be some suggestion in the prior art for the modification, but the modification must not destroy the intended purpose of the reference. However, as the Applicant will explain below, the requisite modification to Chliwnyj would render Chliwnyj inoperative for its intended purpose.

As discussed above, Chliwnyj teaches an electronic lighting device for simulating a candle flame. The lighting device comprises a microprocessor having a number of pulse-width modulation (PWM) outputs, and a number LEDs each emitting one of two or three different colours, with each LED being connected between a common DC voltage source and a respective one of the PWM outputs. The microprocessor indexes a table of sinewave amplitude values to generate independent periodic waveforms for each LED, and is programmed to independently vary the frequency of each waveform and to independently change from one frequency to another so as to provide a number of different illumination effects. As the patentee discloses at column 7, line 7 to column 8, line 2 of the patent, the individual sinusoids are modulated at different frequencies so at to vary the intensity of light emitted by each LED independently of the other LEDs. In this manner, the lighting system is able to mimic the appearance of a real candle flame. However, if Chliwnyj were modified by replacing each uni-colour LED with a multi-colour LED each having first and second differently-coloured illuminating elements, and by replacing the PWM outputs or triacs with a first electronic switch coupled to all the first illuminating elements and a second electronic switch coupled to all the second illuminating elements, as in the invention recited in amended claim 1 of the subject patent application, it would be impossible to vary the LEDs independently of one another. Therefore, it would be impossible for the lighting

device taught by Chliwnyj to achieve its intended purpose, namely the realistic reproduction of a candle flame.

Summarizing the foregoing, neither Chliwnyj nor Gray discloses or suggests a lighting system which uses multi-coloured lamps, with each multi-coloured lamp having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour. Further neither Chliwnyj nor Gray discloses or suggests a lighting system which uses a lamp controller which includes a first electronic switch coupled to all of the first illuminating elements and a second electronic switch coupled to all of the second illuminating elements. In addition, if Chliwnyj were modified to incorporate these features, it would be impossible for the lighting device taught by Chliwnyj to achieve its intended purpose. Therefore, the cited prior art references cannot properly be used as a basis for a *prima facie* obviousness rejection of the invention recited in claim 1 of the subject patent application.

The third basis for the Applicant's position that the invention recited in amended claim 1 of the subject patent application is not obvious in view of Chliwnyj and Gray is that the cited prior art actually teaches away from the claimed invention. As discussed above, Chliwnyj teaches a lighting device comprising separate and distinct uni-coloured lamps, and a number of control ports (eg. microprocessor PWM outputs or triacs) each being connected to and controlling only a single one of the lamps. Gray teaches a lighting device comprising separate strings of conventional Christmas/ornamental lights, and a number of AC switches each being connected to and controlling only a single string of the lights. Accordingly, a person skilled in the art well versed with the teachings of Chliwnyj and Gray, and faced with the problem of designing a simple variable-effect lighting system, would be directed by Chliwnyj and Gray to use uni-coloured lamps, and would not be directed to use multicoloured lamps each comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour, as recited in amended claim 1 of the subject patent application. Accordingly, in view of the fact that the cited prior art

references cannot properly be used as a basis for a *prima facie* obviousness rejection of the invention recited in claim 1 of the subject patent application, and in view of the fact that the cited prior art references teach away from the invention recited in claim 1 of the subject patent application, the Applicant submits that the recited invention is not obvious in view of the prior art.

As claims 2, 3, 11 and 14 depend from independent claim 1, the foregoing arguments apply equally to claims 2, 3, and 11 to 14. Accordingly, the Applicant respectfully requests that the Examiner's rejection of claims 1, 2, 3 and 11, and the Examiner's objection to claims 12 to 14, be withdrawn.

Rejection of Claims 18 to 22

Independent claim 18 of the subject patent application relates to a variable-effect night light. The claimed night light, as amended herein, comprises:

a lamp assembly comprising at least one multi-coloured lamp in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element; and

an AC/DC converter providing the DC voltage source.

The Examiner will note that the limitations of claim 21 (objected to only for being dependent upon a rejected base claim) have been substantially incorporated into amended claim 18. A distinguishing feature of the invention, as recited in amended claim 18, is that the lamp assembly comprises a number of multi-coloured lamps in parallel with a DC voltage source, with each

multi-coloured lamp including a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour, and that the lamp controller includes a first electronic switch coupled to all of the first illuminating elements and a second electronic switch coupled to all of the second illuminating elements. Accordingly, the foregoing arguments apply equally to claim 18, and the Applicant submits that the invention recited in claim 18, as amended herein, is neither anticipated nor obvious in view of the prior art.

As claims 19, 20 and 22 depend from independent claim 18, the foregoing arguments apply equally to claims 19, 20 and 22. Accordingly, the Applicant respectfully requests that the Examiner's rejection of claims 18, 19, 20 and 22 be withdrawn.

Rejection of Claims 23 to 26

Independent claim 23 of the subject patent application relates to a variable-effect jewelry piece. The claimed jewelry piece, as amended herein, comprises:

a lamp assembly comprising at least one multi-coloured lamp in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element; and

a DC power source for powering the lamp assembly and the controller

A distinguishing feature of the invention, as recited in amended claim 23, is that the lamp assembly comprises a number of multi-coloured lamps in parallel with a DC voltage source, with each multi-coloured lamp including a first illuminating element for producing a first colour of

light, and a second illuminating element for producing a second colour of light different from the first colour, and that the lamp controller includes a first electronic switch coupled to all of the first illuminating elements and a second electronic switch coupled to all of the second illuminating elements. Accordingly, the foregoing arguments apply equally to claim 23, and the Applicant submits that the invention recited in claim 23, as amended herein, is neither anticipated nor obvious in view of the prior art.

As claims 24 to 26 depend from independent claim 23, the foregoing arguments apply equally to claims 24 to 26. Accordingly, the Applicant respectfully requests that the Examiner's rejection of claims 23 to 26 be withdrawn.

Rejection of Claims 27 to 30

Independent claim 27 of the subject patent application relates to a variable-effect key chain. The claimed key chain comprises:

a lamp assembly comprising at least one multi-coloured lamp in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element;

a DC power source for powering the lamp assembly and the controller;

a housing retaining the lamp assembly, the controller and the power source therein; and

retaining means coupled to the housing for retaining keys therein.

A distinguishing feature of the invention, as recited in amended claim 27, is that the lamp assembly comprises a number of multi-coloured lamps in parallel with a DC voltage source, with

each multi-coloured lamp including a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour, and that the lamp controller includes a first electronic switch coupled to all of the first illuminating elements and a second electronic switch coupled to all of the second illuminating elements. Accordingly, the foregoing arguments apply equally to claim 27, and the Applicant submits that the invention recited in claim 27, as amended herein, is neither anticipated nor obvious in view of the prior art.

As claims 28 to 30 depend from independent claim 27, the foregoing arguments apply equally to claims 28 to 30. Accordingly, the Applicant respectfully requests that the Examiner's rejection of claims 27 to 30 be withdrawn.

New Claims 31 to 33

Independent claim 31 of the subject patent application relates to a variable-effect lighting system. The claimed lighting system comprises:

a lamp assembly comprising a string of multi-coloured lamps in series with an AC voltage source and in series with each other, the AC voltage source having a first voltage phase and a second voltage phase opposite the first phase, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light during the first voltage phase, and a second illuminating element for producing a second colour of light different from the first colour during the second voltage phase; and

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller.

A distinguishing feature of the invention, as recited in new claim 31, is that the lamp assembly comprises a string of series-coupled multi-coloured lamps in series with an AC voltage source, with each multi-coloured lamp including a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from

the first colour. In this manner, the lamp controller is able to control the conduction angle of each illuminating element and thereby control the illumination effects produced by a number of multi-coloured lamps. None of the prior art references cited by the Examiner or provided by the Applicant, either alone or in combination, teach or suggest an invention including this arrangement.

As discussed above, Gray teaches a programmable lighting control system, comprising a number of independent AC receptacles for receiving strings of series or parallel connected lights, and controller electronics for controlling the receptacles. The controller electronics comprises a microprocessor, a memory storing program instructions for the microprocessor, a number of AC switches controlled by the microprocessor for independently controlling the timing and intensity of light emitted by the lights, a serial interface for downloading program instructions into the memory, and a rotary switch for selecting either a pre-programmed or user-defined lighting sequence. Gray does not teach a lighting system comprising a lamp assembly including a string of series-coupled multi-coloured lamps in series with an AC voltage source, with each multi-coloured lamp having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour, as recited in new claim 31 of the subject patent application. Consequently, the invention recited in new claim 31 is not anticipated by Gray.

Chliwnyj teaches an electronic lighting device that simulates an electronic flame, comprising a microprocessor having a number of pulse-width modulation (PWM) outputs, and a number of uni-colour LEDs each emitting one of two or three different colours, with each LED being connected in parallel with one another between a common DC voltage source and a respective one of the PWM outputs. Chliwnyj does not teach a lighting system comprising a lamp assembly including a string of series-coupled multi-coloured lamps in series with an AC voltage source, with each multi-coloured lamp having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different

from the first colour, as recited in new claim 31 of the subject patent application. Consequently, the invention recited in new claim 31 is not anticipated by Chliwnyj.

The Applicant also submits that the invention recited in new claim 31 of the subject patent application is not obvious in light of Gray and Chliwnyj. The Applicant puts forth two bases for this submission. The initial basis of the Applicant's position is that for a *prima facie* obviousness rejection to be raised in view of a modification to a prior art reference, there must be some suggestion in the prior art for the modification. However, as the Applicant will explain below, the requisite suggestion is lacking.

As discussed above, new claim 31 relates to a lighting system comprising a string of series-coupled multi-coloured lamps in series with an AC voltage source, with each multi-coloured lamp including a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour. Although Gray teaches an electronic lighting device which includes a number of series-coupled lamps in series with an AC voltage source, Gray fails to disclose or suggest the use of multi-coloured lamps, with each multi-coloured lamp having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour. Chliwnyj fails to disclose or suggest the use of series-coupled multi-coloured lamps in series with an AC voltage source, with each multi-coloured lamp having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour. Accordingly, as none of the references located by the Examiner or provided by the Applicant disclose a lighting system including these features, the requisite suggestion in the prior art for the modification of Gray is lacking. Therefore, the cited prior art references cannot properly be used as a basis for a *prima facie* obviousness rejection of the invention recited in claim 31 of the subject patent application.

The second basis for the Applicant's position that the invention recited in new claim 31 of the subject patent application is not obvious in view of Gray and Chliwnyj is that the cited prior art actually teaches away from the claimed invention. As discussed above, Gray teaches a lighting device comprising separate strings of conventional Christmas/ornamental lights, and a number of AC switches each being connected to and controlling only a single string of the lights. Chliwnyj teaches a lighting device comprising separate and distinct uni-coloured lamps, and a number of control ports each connected to and controlling only a single one of the lamps. Accordingly, a person skilled in the art well versed with the teachings of Gray and Chliwnyj, and faced with the problem of designing a simple variable-effect lighting system, would be directed by Gray and Chliwnyj to use uni-coloured lamps, and would not be directed to use a series string of multicoloured lamps each comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour, as recited in new claim 31 of the subject patent application. Accordingly, in view of the fact that the cited prior art references cannot properly be used as a basis for a *prima facie* obviousness rejection of the invention recited in claim 31 of the subject patent application, and in view of the fact that the cited prior art references teach away from the invention recited in claim 31 of the subject patent application, the Applicant submits that the recited invention is not obvious in view of the prior art.

Favourable reconsideration of the subject patent application is respectfully requested.

If any additional fees are required by any of the foregoing amendments or submissions, permission is hereby granted to debit our deposit account number 07-1750.

If the Examiner wishes to discuss any aspect of this amendment, please contact the Applicant's patent agent, Mr. Robert Graham, at (416) 862-4425.

Respectfully submitted,

Robert J. Graham
Reg No. 43,430

INTELLECTUAL PROP.\258415_1
October 17, 2000

UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

Paper No. 7

GOWLING STRATHY & HENDERSON
SUITE 4900
4900 COMMERCE COURT WEST
TORONTO ON M5L IJ3
CANADA

COPY MAILED

FEB 1 3 2001

OFFICE OF PETITIONS
A/C PATENTS

In re Application of
James Ruxton
Application No. 09/295,367
Filed: April 21, 1999
Attorney Docket No. T8464953US

ON PETITION

This is a decision on the petition under 37 CFR 1.137(b), filed October 25, 2000, to revive the above-identified application.

The petition is **GRANTED**.

The above-identified application became abandoned for failure to reply in a timely manner to the non-final Office action mailed March 24, 2000, which set a shortened statutory period for reply of three (3) months. No extensions of time under the provisions of 37 CFR 1.136(a) were obtained. Accordingly, the above-identified application became abandoned on June 25, 2000.

Telephone inquiries concerning this decision should be directed to Irvin Dingle at (703) 306-5684.

The application file is being forwarded to Technology Center 2800.

Irvin Dingle
Petitions Examiner
Office of Petitions
Office of the Deputy Commissioner
for Patent Examination Policy

AK

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/295,367	04/21/99	RUXTON J	T8464953US

MM91/0424

GOWLING STRATHY & HENDERSON
SUITE 4900
4900 COMMERCE COURT WEST
TORONTO ON M5L IJ3
CANADA

AIR MAIL

EXAMINER	
TRAN, T	
ART UNIT	**PAPER NUMBER**
2821	

DATE MAILED: 04/24/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

PTO-90C (Rev.11/00)

1- File Copy

Notice of Allowability	Application No.	Applicant(s)	
	09/295,367	RUXTON, JAMES	
	Examiner	Art Unit	
	THUY V. TRAN	2821	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance and Issue Fee Due or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the communications on 10/25/2000 and the decision of the Office of Petitions on 02/13/2001*.
2. ☒ The allowed claim(s) is/are *1-3,6,11,14,18-20 and 22-33*.
3. ☐ The drawings filed on _____ are acceptable as formal drawings.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.
5. ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application. **THIS THREE-MONTH PERIOD IS NOT EXTENDABLE FOR SUBMITTING NEW FORMAL DRAWINGS , OR A SUBSTITUTE OATH OR DECLARATION. This three-month period for complying with the REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL is extendable under 37 CFR 1.136(a).**

6. ☐ Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient. A SUBSTITUTE OATH OR DECLARATION IS REQUIRED.

7. ☒ Applicant MUST submit NEW FORMAL DRAWINGS
   (a) ☒ including changes required by the Notice of Draftsperson's Patent Drawing Review(PTO-948) attached
      1) ☐ hereto or 2) ☒ to Paper No. *3*.
   (b) ☐ including changes required by the proposed drawing correction filed _____, which has been approved by the examiner.
   (c) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No. _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings. The drawings should be filed as a separate paper with a transmittal letter addressed to the Official Draftsperson.

8. ☐ Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Any reply to this letter should include, in the upper right hand corner, the APPLICATION NUMBER (SERIES CODE / SERIAL NUMBER). If applicant has received a Notice of Allowance and Issue Fee Due, the ISSUE BATCH NUMBER and DATE of the NOTICE OF ALLOWANCE should also be included.

Attachment(s)

1☐ Notice of References Cited (PTO-892)
2☐ Notice of Informal Patent Application (PTO-152)
3☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
4☐ Interview Summary (PTO-413), Paper No.____ .
5☐ Information Disclosure Statements (PTO-1449), Paper No. ____.
6☐ Examiner's Amendment/Comment
7☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
8☒ Examiner's Statement of Reasons for Allowance
9☐ Other .

Reasons for Allowance

1. The following is an examiner's statement of reasons for allowance:

Prior art fails to disclose or suggest a lamp controller having (1) a first illuminating element coupled to the DC source through a first electronic switch, (2) a second illuminating element coupled to the DC source through a second electronic switch, and (3) a feature of setting a conduction angle of the illuminating elements, as claimed in independent claims 1, 18, 23, 27, and 31.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Inquiry

Any inquiry concerning this communication or earlier communications from the examiner should be directed to THUY V. TRAN whose telephone number is (703)305-0012. The examiner can normally be reached on M-F (8:30-6:00) First Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, DON K. WONG can be reached on (703)308-4856. The fax phone numbers for the organization where this application or proceeding is assigned are (703)308-7722 for regular communications and (703)308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)308-0956.

Thuy V. Tran
April 19, 2001

DAVID VU
PRIMARY EXAMINER

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

NOTICE OF ALLOWANCE AND ISSUE FEE DUE

NM91/0424
GOWLING STRATHY & HENDERSON
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4900 COMMERCE COURT WEST
TORONTO ON M5L 1J3
CANADA

AIR MAIL

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
09/295,367	04/21/99	021	TRAN, T 2821	04/24/01
First Named Applicant RUXTON,		35 USC 154(b) term ext. = 0 Days.		

TITLE OF INVENTION VARIABLE-EFFECT LIGHTING SYSTEM

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
2 T8464953US	315-312.000	F49	UTILITY	YES	$620.00	07/24/01

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.

THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED.

HOW TO RESPOND TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.
If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is changed, pay twice the amount of the FEE DUE shown above and notify the Patent and Trademark Office of the change in status, or
B. If the status is the same, pay the FEE DUE shown above.

If the SMALL ENTITY is shown as NO:

A. Pay FEE DUE shown above, or

B. File verified statement of Small Entity Status before, or with, payment of 1/2 the FEE DUE shown above.

II. Part B-Issue Fee Transmittal should be completed and returned to the Patent and Trademark Office (PTO) with your ISSUE FEE. Even if the ISSUE FEE has already been paid by charge to deposit account, Part B Issue Fee Transmittal should be completed and returned. If you are charging the ISSUE FEE to your deposit account, section "4b" of Part B-Issue Fee Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give application number and batch number.
Please direct all communications prior to issuance to Box ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PATENT AND TRADEMARK OFFICE COPY

PTOL-85 (REV. 10-96) Approved for use through 06/30/99. (0651-0033)

TRANSMITTAL OF FORMAL DRAWINGS	Docket No. T8464953US

In Re Application Of: **James Ruxton**

Serial No.	Filing Date	Batch No.	Examiner	Art Unit
09/295,367	04/21/1999	F49	T. Tran	2821

Invention: **Variable-Effect Lighting System**

Address to:
Assistant Commissioner for Patents
Washington, D.C. 20231

RECEIVED
JUL 23 2001
Office of Patent Publication
Director's Office

Transmitted herewith are:

8 sheets of formal drawing(s) for this application.

Each sheet of drawing indicates the identifying indicia suggested in 37 CFR Section 1.84(c) on the reverse side of the drawing.

Rob Gaikema 43,430
Signature

Dated: 20 July 2001

I certify that this document and attached formal drawings are being deposited on with the U.S. Postal Service as first class mail under 37 C.F.R. 1.8 and addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Signature of Person Mailing Correspondence

Typed or Printed Name of Person Mailing Correspondence

P23B/REV01

4/01

6285140

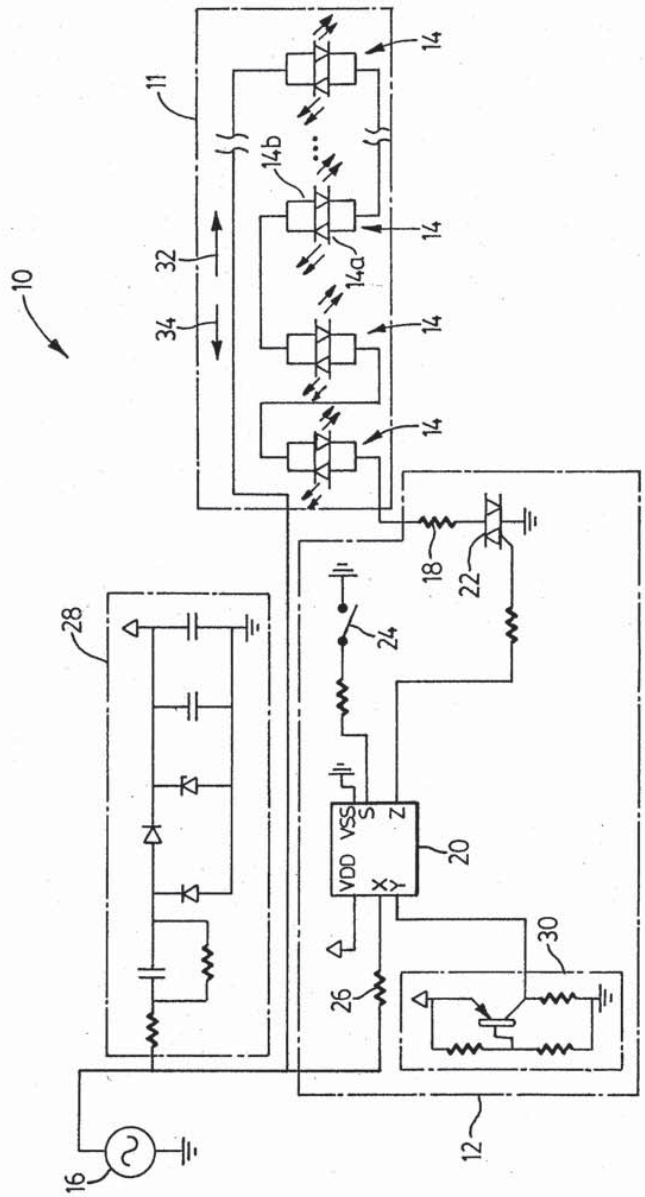


FIG. 1a

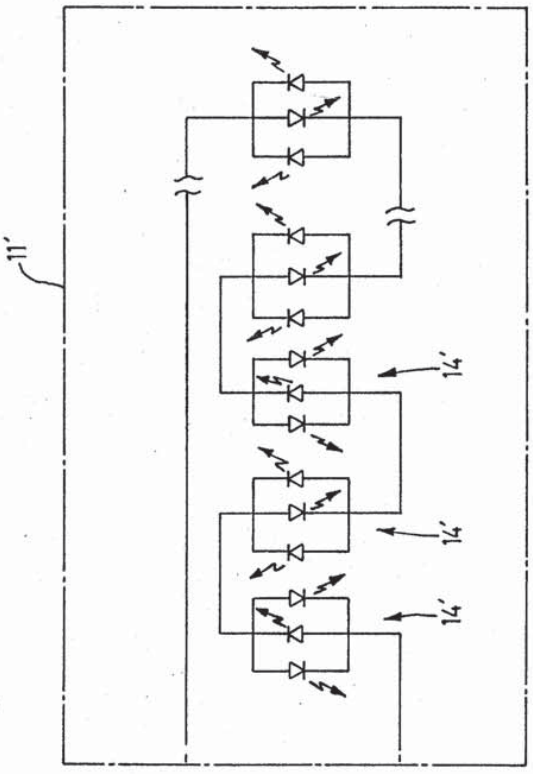
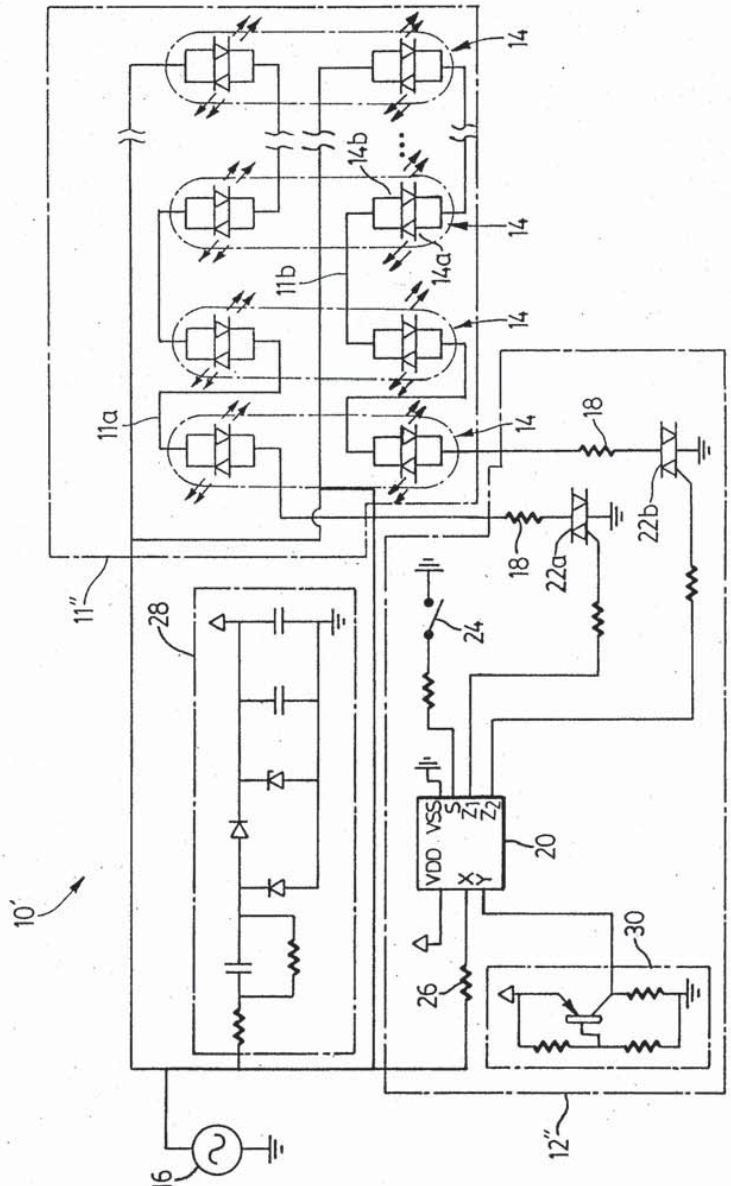


FIG. 1b


10'
11"
11a
11b
12"
14
14a
14b
16
18
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22a
22b
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26
28
30
VDD
VSS
S
Z1
Z2
X
Y

FIG. 1c

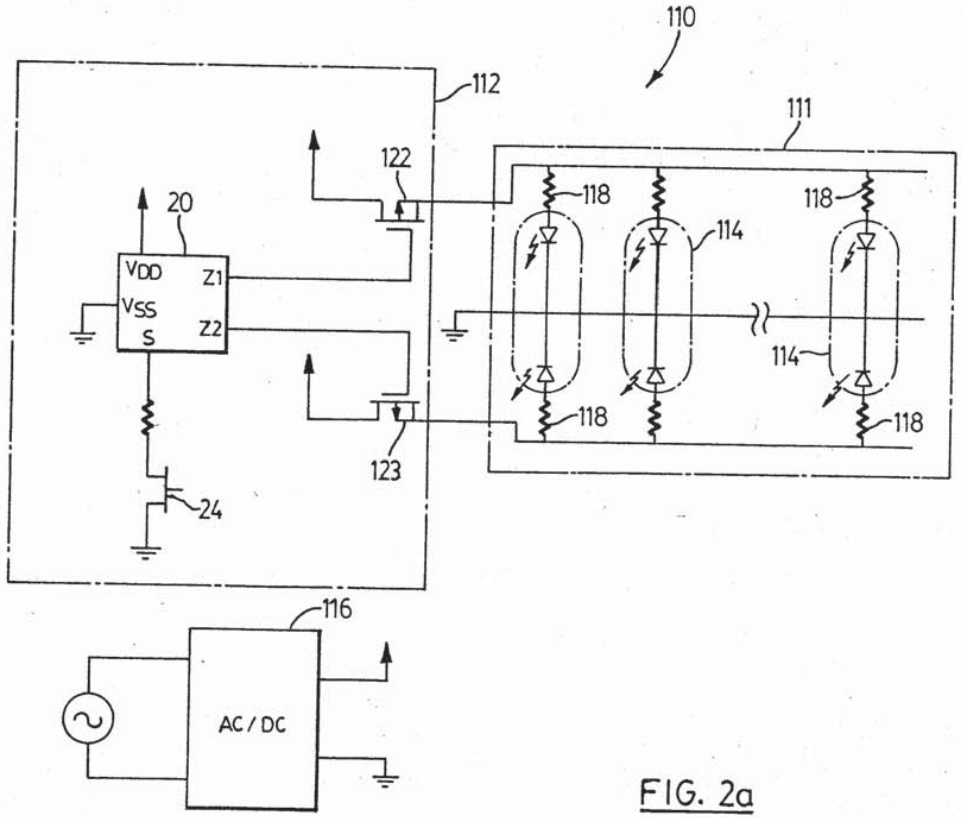
110
112
111
122
20
VDD
Z1
VSS
Z2
S
118
114
118
114
118
118
123
24
116
AC / DC

FIG. 2a

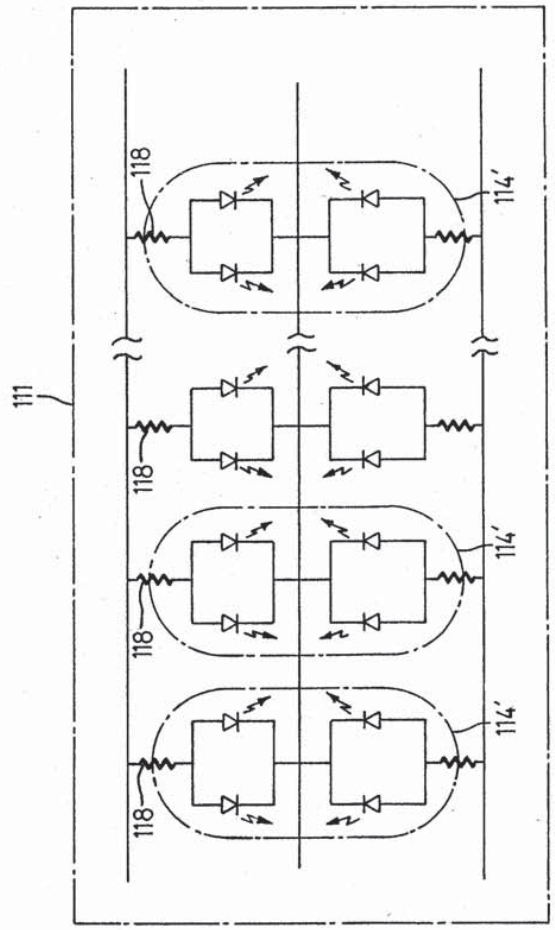

FIG. 2b

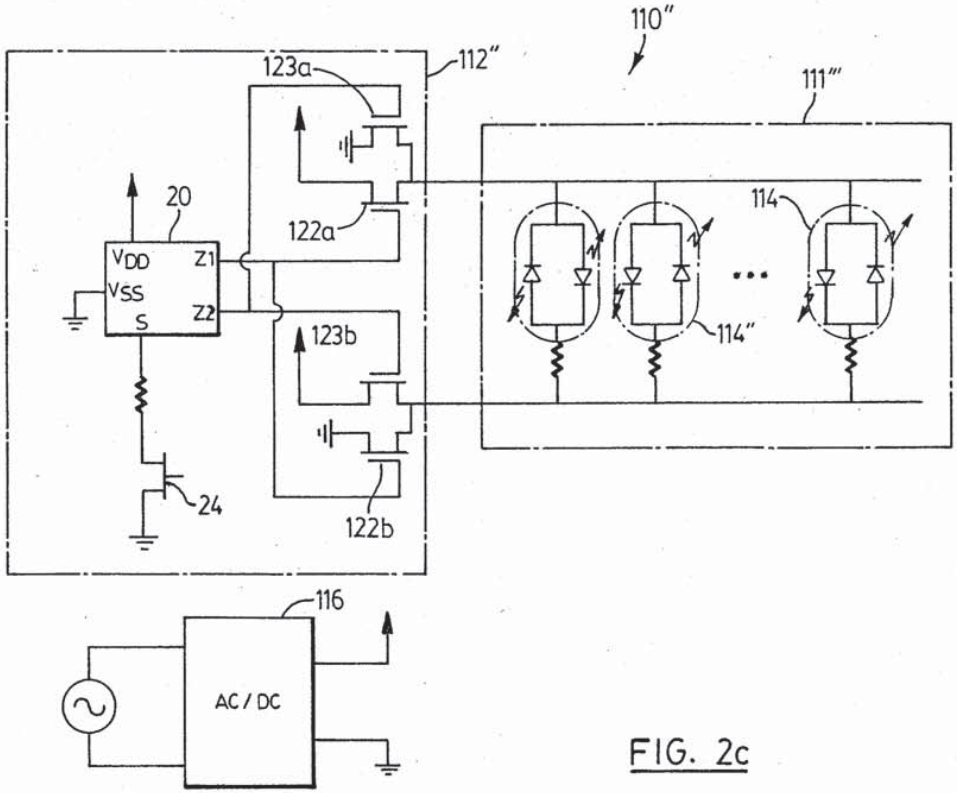
110"
112"
123a
111'"
20
122a
114
V_{DD}
Z1
Vss
Z2
S
123b
114"
24
122b
116
AC / DC

FIG. 2c

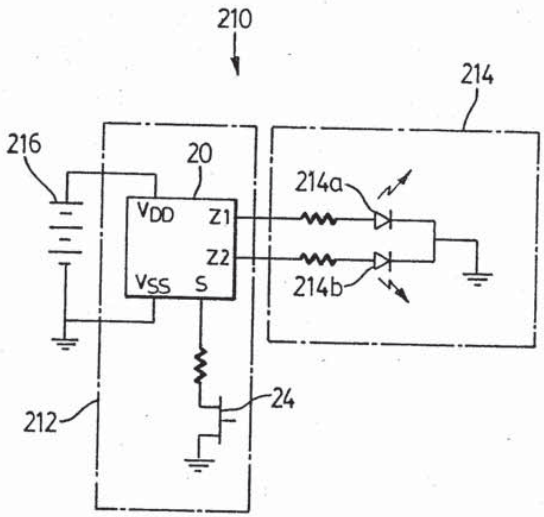
210
214
216
20
214a
VDD
Z1
Z2
VSS
S
214b
24
212

FIG. 3

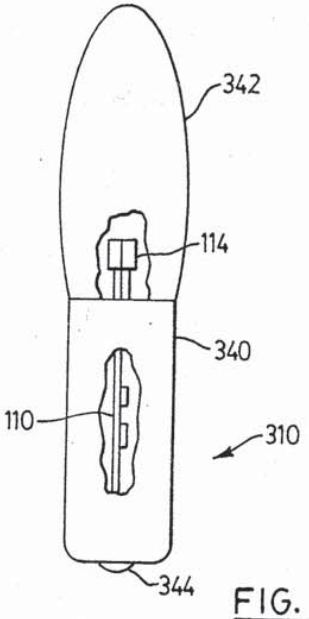
342
114
340
110
310
344

FIG. 4

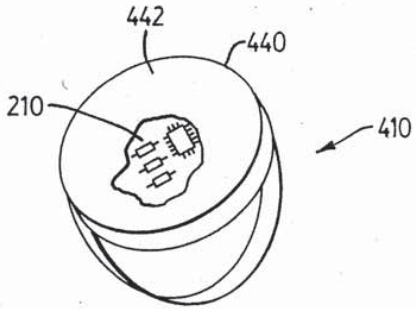

FIG. 5a

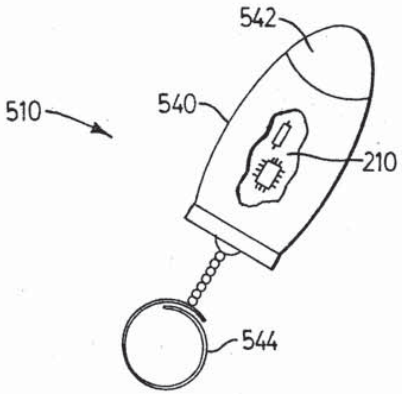

FIG. 5b

JUL 23 2001 PATENT & TRADEMARK OFFICE

PART B—ISSUE FEE TRANSMITTAL

Complete and mail this form, together with applicable fees, to: **Box ISSUE FEE**
Assistant Commissioner for Patents
Washington, D.C. 20231

MAILING INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE. Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Issue Fee Receipt, the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any corrections or use Block 1)

MM91/0424
GOWLING STRATHY & HENDERSON
SUITE 4900
4900 COMMERCE COURT WEST
TORONTO ON M5L IJ3
CANADA

AIR MAIL

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Certificate of Mailing

I hereby certify that this Issue Fee Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Box Issue Fee address above on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
09/295,367	04/21/99	021	TRAN, T 2821	04/24/01

First Named Applicant: RUXTON, — 35 USC 154(b) term ext. = 0 Days.

TITLE OF INVENTION: VARIABLE-EFFECT LIGHTING SYSTEM

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
2 T8464953US	315-312.000	F49	UTILITY	YES	$620.00	07/24/01

1. Change of correspondence address or indication of " Fee Address" (37 CFR 1.363). Use of PTO form(s) and Customer Number are recommended, but not required.
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47) attached.

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 Gowling Lafleur
2 Henderson LLP
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)
PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the PTO or is being submitted under separate cover. Completion of this form is NOT a subsitiute for filing an assignment.
(A) NAME OF ASSIGNEE Pharos Innovations Inc.
(B) RESIDENCE: (CITY & STATE OR COUNTRY) Toronto, Ontario, Canada
Please check the appropriate assignee category indicated below (will not be printed on the patent)
☐ Individual ☒ Corporation or other private group entity ☐ government

4a. The following fees are enclosed (make check payable to Commissioner of Patents and Trademarks):
☐ Issue Fee
☐ Advance Order - # of Copies

4b. The following fees or deficiency in these fees should be charged to:
DEPOSIT ACCOUNT NUMBER 07-1750
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☒ Advance Order - # of Copies three

The COMMISSIONER OF PATENTS AND TRADEMARKS IS requested to apply the Issue Fee to the application identified above.

(Authorized Signature) Rob G— 43,430 (Date) 20 July 2001

NOTE; The Issue Fee will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the Patent and Trademark Office.

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07/25/2001 TTHAM2 00000060 07-1750
01 FC:540 620.00 CH
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6285140 OCS

SEP-01-2005 00:13 HEENAN BLAIKIE 416 360 8425 P.01/07

Heenan Blaikie

FACSIMILE TRANSMISSION SHEET

RECIPIENT(S)	**Maintenance Fee Department** **• F 571-273-6500**
SENDER	**Robert Graham** T 416 360.3524 • F 416 360.8425
DATE	September 1, 2005
OUR REFERENCE	**039310-0004US**
SUBJECT	**Maintenance Fee Payment**

OMPLETED

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NOV 04 2005

Total Number of Pages: 7 (including this sheet)

I, Robert Graham, hereby certify that I forwarded the attached correspondence to the United States Patent and Trademark Office by facsimile on the date identified above.

P.O. Box 185, Suite 2600
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South Tower, Royal Bank Plaza
Toronto, Ontario
Canada M5J 2J4

www.heenanblaikie.com

Rob Graham Reg No. 43,430

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SEP 16 2005

PAGE 1/7 * RCVD AT 9/1/2005 12:13:51 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-6/27 * DNIS:2736500 * CSID:416 360 8425 * DURATION (mm-ss):02-32

PTO/SB/21 (09-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission

Application Number	09/295,367
Filing Date	04/21/1999
First Named Inventor	RUXTON, James
Art Unit	
Examiner Name	
Attorney Docket Number	039310-0004US

ENCLOSURES *(Check all that apply)*

- [x] Fee Transmittal Form
  - [x] Fee Attached
- [ ] Amendment/Reply
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Reply to Missing Parts/ Incomplete Application
  - [ ] Reply to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert to a Provisional Application
- [x] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s) _____
  - [ ] Landscape Table on CD
- [ ] After Allowance Communication to TC
- [ ] Appeal Communication to Board of Appeals and Interferences
- [ ] Appeal Communication to TC (Appeal Notice, Brief, Reply Brief)
- [ ] Proprietary Information
- [ ] Status Letter
- [x] Other Enclosure(s) (please identify below):

Remarks

Fee Address Indication Form
Notification of Change in Entity Status

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Heenan Blaikie LLP		
Signature			
Printed name	Robert J. Graham		
Date	09/01/2005	Reg. No.	43,430

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PTO/SB/123 (04-05)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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Patent

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Commissioner for Patents
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Alexandria, VA 22313-1450

Patent Number	6,285,140
Issue Date	09/04/2001
Application Number	09/295,387
Filing Date	04/21/1999
First Named Inventor	RUXTON, James
Attorney Docket Number	039310-0004US

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I am the:

☐ Patentee.

☐ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

☑ Attorney or agent of record. Registration Number 43,430.

Signature

Typed or Printed Name Robert J. Graham

Date 09/01/2005 | Telephone (416) 360-3524

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☐ *Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop Post Issue, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/295,367	04/21/1999	JAMES RUXTON	T8464953US

CONFIRMATION NO. 7089

OC000000018978383

46127
HEENAN BLAIKIE LLP
P. O. BOX 185, SUITE 2600, 200 BAY STREET
SOUTH TOWER, ROYAL BANK PLAZA
TORONTO, ON M5J 2J4
CANADA

Date Mailed: 05/26/2006

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/16/2005.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

ANITA C GREENE
OIPE (703) 308-9010

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www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/295,367	04/21/1999	JAMES RUXTON	T8464953US

CONFIRMATION NO. 7089

OC000000018978375

GOWLING STRATHY & HENDERSON
SUITE 4900
4900 COMMERCE COURT WEST
TORONTO, M5LIJ3
CANADA

Date Mailed: 05/26/2006

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/16/2005.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

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OIPE (703) 308-9010

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Name:	HEENAN BLAIKIE LLP
Address:	BAY ADELAIDE CENTRE 333 BAY STREET, SUITE 2900, P.O. BOX 2900 TORONTO ON M5H 2T4
Customer Number:	46127

Attorney/Agent Information

Reg #	Name	Phone
43430	Graham, Robert	416-865-3533

FORM PTO-1002 (REV. 6-76)

U. S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

NEW PATENT APPLICATION CHECKLIST FOR MATTERS OF FORM

SERIAL NO. 09/295304

Examiner:
The items checked below have been noted in processing this application as filed.
After the typist has included these statements in the first Office action, please initial this form in the margin to the left of the appropriate paragraph. Please do NOT remove from the file jacket.

1. SPECIFICATION, JUMBO APPLICATION NOT CHECKED FOR MINOR ERRORS (If more than 20 pages of description, exclusive of claims.)

☒ Because of the lengthy specification in this application, it has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is therefore requested in promptly correcting any errors of which he may become aware in the specification or drawings.

2. RESIDENCE OMITTED (MPEP 605.02 and 603.03)

☐ Applicant's residence has been omitted from the papers. The city and state of his post-office address will be presumed to be the city and state of his residence. If the above is incorrect, applicant should submit a statement of his place of residence no later than at the time of payment of the issue fee.

3. PRIORITY PAPERS, ACKNOWLEDGMENT (MPEP 201.14(c))

☐ Receipt is acknowledged of papers submitted under 35 U.S.C. 119, which papers have been placed of record in the file.

4. PRIORITY PAPERS, ACKNOWLEDGMENT, PAPERS IN PARENT APPLICATION (MPEP 201.14(b))

☐ Applicant's claim for priority, based on papers filed in parent application Serial No. _____ submitted under 35 U.S.C. 119, is acknowledged.

5. PRIORITY, CLAIM FOR BUT NO PAPERS FILED (MPEP 201.14(c))

☐ Acknowledgment is made of applicant's claim for priority based on an application filed in _____ on _____. It is noted, however, that applicant has not filed a certified copy of said application as required by 35 U.S.C. 119.

6. PRIORITY PAPERS, MORE THAN ONE YEAR SINCE FILING IN FOREIGN COUNTRY (MPEP 201.14(c))

☐ Receipt is acknowledged of the filing on _____, of a certified copy of the _____ application referred to in the _____.* A claim for priority can not be based on said application, since the United States application was filed more than twelve months thereafter.

7. PRIORITY, REFERENCE IN OATH OR DECLARATION OMITTED (MPEP 201.14(c))

☐ Receipt is acknowledged of papers filed _____, based on an application filed in _____ on _____. Applicant has not complied with the requirements of Rule 65(a), since the _____* does not acknowledge the filing of any foreign application. A new _____* is required.

* INSERT EITHER "DECLARATION" OR "OATH" WHICHEVER IS APPLICABLE.

CLERK RJ

DATE 6/12/99

*U.S. GPO: 1997-417-376/60306

PATENT APPLICATION FEE DETERMINATION RECORD

Effective November 10, 1998

Application or Docket Number: 09295367

CLAIMS AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA
BASIC FEE		
TOTAL CLAIMS	30 minus 20=	* 10
INDEPENDENT CLAIMS	4 minus 3 =	* 1
MULTIPLE DEPENDENT CLAIM PRESENT		

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐	RATE	FEE	OR	OTHER THAN SMALL ENTITY	RATE	FEE
		380.00	OR			760.00
	X$ 9=		OR		X$18=	180
	X39=		OR		X78=	78
	+130=		OR		+260=	
	TOTAL		OR		TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 27	Minus	** 30	=
Independent	* 5	Minus	*** 4	= 1
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				

SMALL ENTITY	RATE	ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY	RATE	ADDITIONAL FEE
	X$ 9=		OR		X$18=	
	X39=		OR		X78=	78
	+130=		OR		+260=	
	TOTAL ADDIT. FEE		OR		TOTAL ADDIT. FEE	78

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X39=		OR	X78=	
+130=		OR	+260=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X39=		OR	X78=	
+130=		OR	+260=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875
(Rev. 8/98)

Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

ISSUE SLIP STAPLE AREA (For additional cross references)

POSITION	INITIALS	ID NO.	DATE
FEE DETERMINATION	ST		4/29
O.I.P.E. CLASSIFIER		7	5/6/99
FORMALITY REVIEW	DB	605323	3/13/99

INDEX OF CLAIMS

✔ ..... Rejected
= ..... Allowed
— (Through numeral)... Canceled
÷ ..... Restricted
N ..... Non-elected
I ..... Interference
A ..... Appeal
O ..... Objected

Claim Final	Claim Original	Date 3/16/00	Date 4/18/01
1	1	✓	=
2	2	✓	=
3	3	✓	=
	4	✓	—
	5	✓	—
19	6	✓	=
	7	✓	—
	8	✓	—
	9	✓	—
	10	✓	—
4	11	✓	=
	12	O	—
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	17	✓	—
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If more than 150 claims or 10 actions staple additional sheet here

(LEFT INSIDE)

[redacted]

SEARCHED

Class	Sub.	Date	Exmr.
315	185S	3/16/2000	T.T.
"	193	"	"
"	194	"	"
"	195	"	"
" →	291	"	"
"	307	"	"
"	308	"	"
" →	309	"	"
" →	312	"	"
" →	315	"	"
"	316	"	"
"	324	"	"
362	234	"	"
updated search		4/18/01	T.T.

SEARCH NOTES
(INCLUDING SEARCH STRATEGY)

	Date	Exmr.
EAST Search	3/16/2000	T.T.

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.
315	312	4/18/01	T.T.
"	309	"	"
"	315	"	"
"	291	"	"

(RIGHT OUTSIDE)

US006285140B1

(12) **United States Patent**
Ruxton

(10) **Patent No.: US 6,285,140 B1**
(45) **Date of Patent: Sep. 4, 2001**

(54) **VARIABLE-EFFECT LIGHTING SYSTEM**

(75) Inventor: **James Ruxton**, Toronto (CA)

(73) Assignee: **Pharos Innovations Inc.**, Toronto (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/295,367**

(22) Filed: **Apr. 21, 1999**

(51) **Int. Cl.**[7] **H05B 37/00**
(52) **U.S. Cl.** **315/312**; 315/291; 315/309; 315/315
(58) **Field of Search** ..... 315/185 S, 193, 315/194, 195, 291, 307, 308, 305, 312, 315, 316, 324; 362/234

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,809,181	6/1931	Ramsden .	
2,515,236	7/1950	Kunins	240/3.1
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3,324,289	6/1967	Cirko	240/10.1
3,379,869	4/1968	Dorman	240/41.3
3,388,245	6/1968	Larsen	240/3.1
3,435,286	3/1969	Kayatt	315/47
3,789,211	1/1974	Kramer	240/10 R
4,317,071	2/1982	Murad	315/312
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5,749,646	5/1998	Brittell	362/231
5,752,766	5/1998	Bailey et al.	362/250
5,924,784 *	7/1999	Chliwnyj et al.	362/234

* cited by examiner

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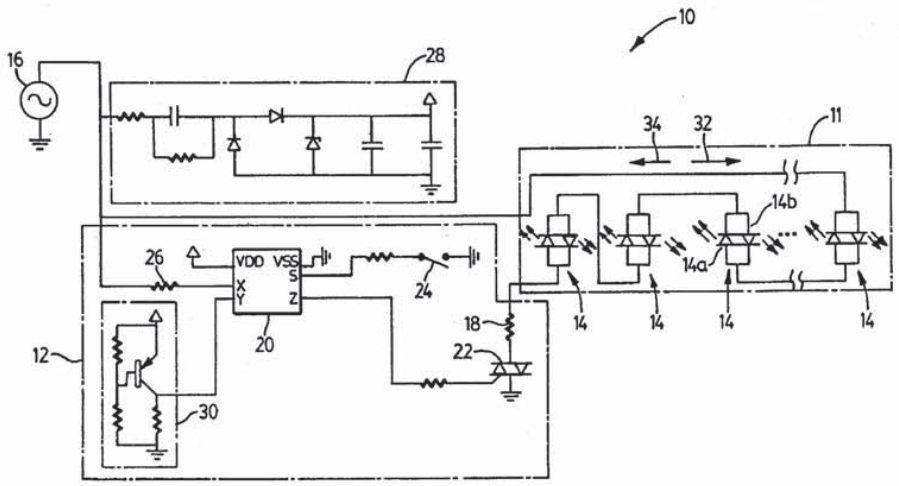
Assistant Examiner—Thuy Vinh Tran
(74) *Attorney, Agent, or Firm*—Gowling Lafleur Henderson LLP

(57) **ABSTRACT**

A variable-effect lighting system includes a lamp assembly, and a programmable lamp controller. The lamp assembly comprises a string of bicolored lamps, each bicolored lamp including a first illuminating element for producing a first color of light, and a second illuminating element for producing a second color of light. The programmable lamp controller is coupled to the lamp assembly for setting the conduction angle of the illuminating elements according to at least one predetermined pattern stored in a memory of the lamp controller. Preferably, the controller includes a user-operable input to allow the user to select the predetermined pattern and hence the color display as desired.

21 Claims, 8 Drawing Sheets



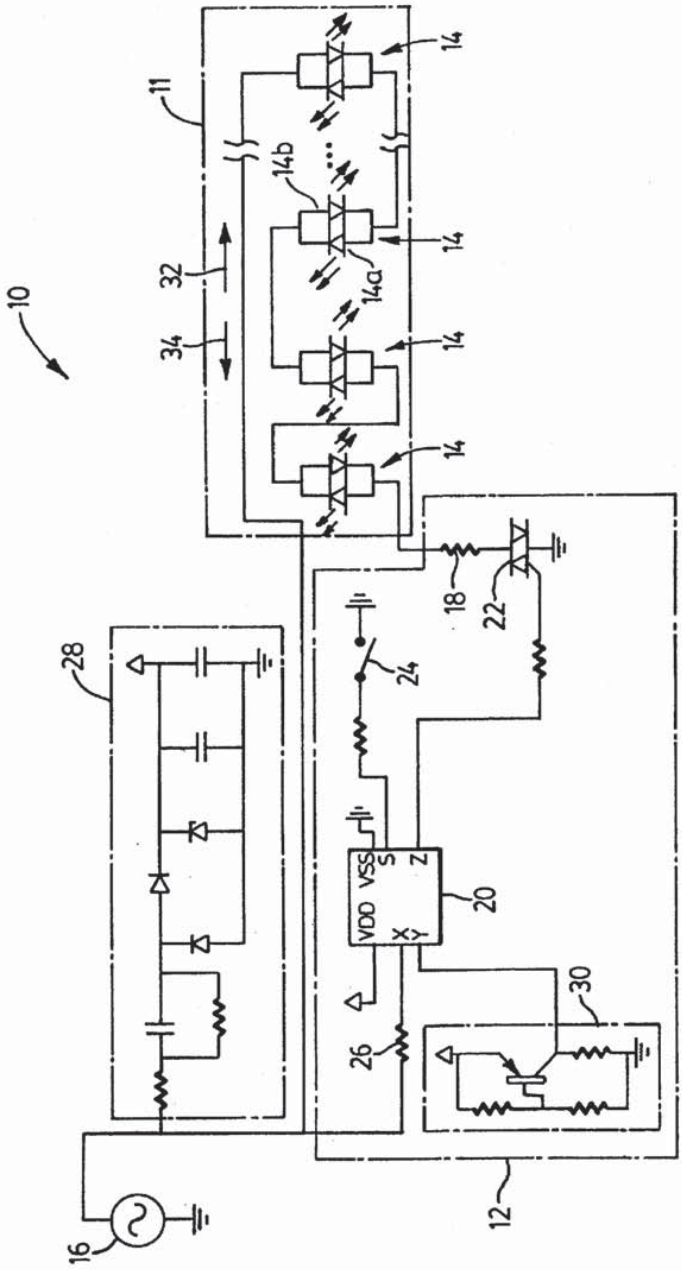


FIG. 1a

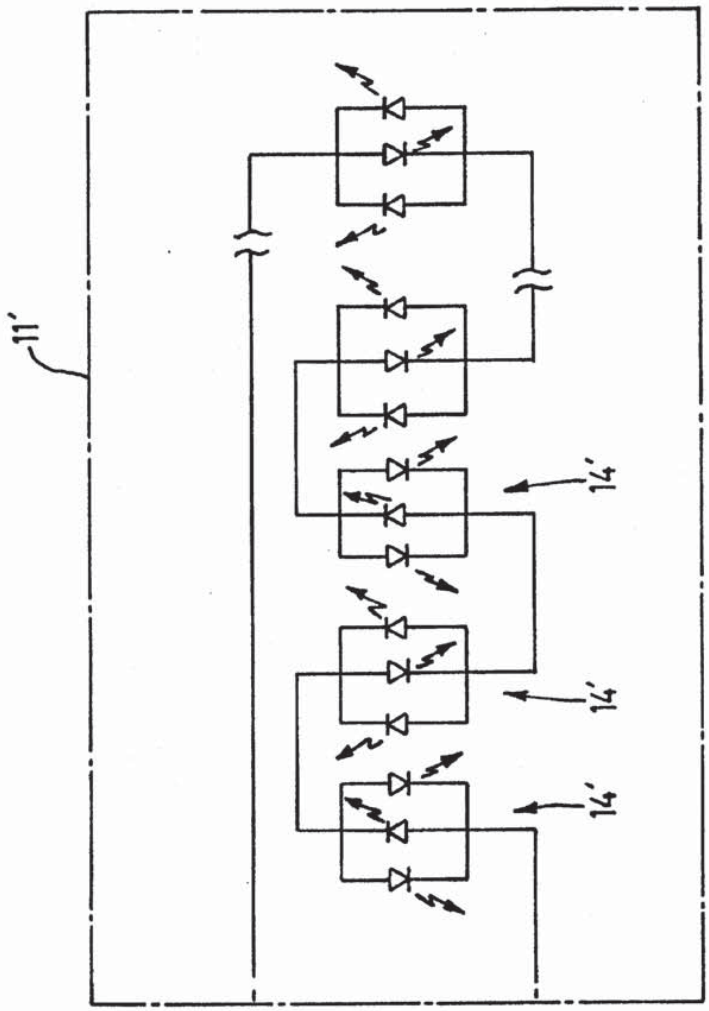


FIG. 1b

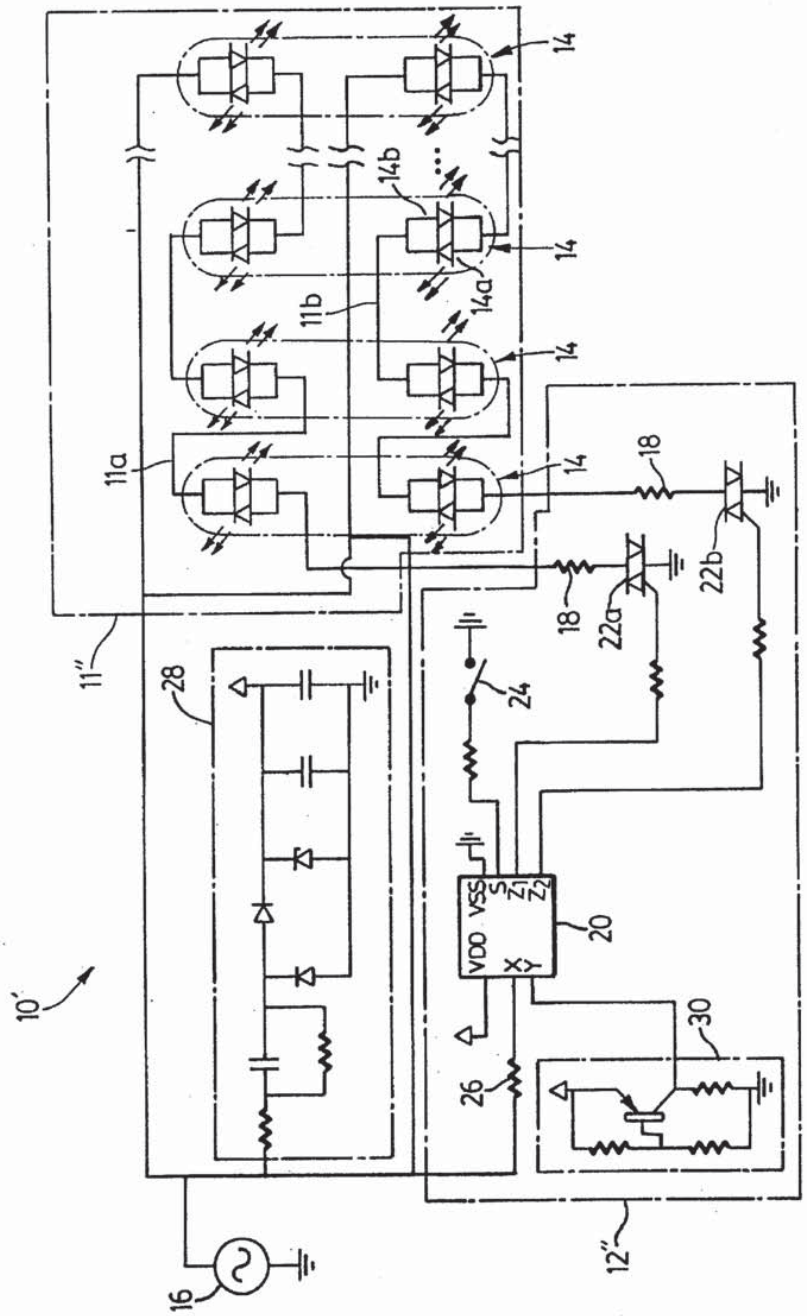

14
14b
14a
11b
11a
11''
28
24
18
22a
22b
VDD
VSS
S
Z1
Z2
X
Y
20
26
30
16
12''
10'

FIG. 1c

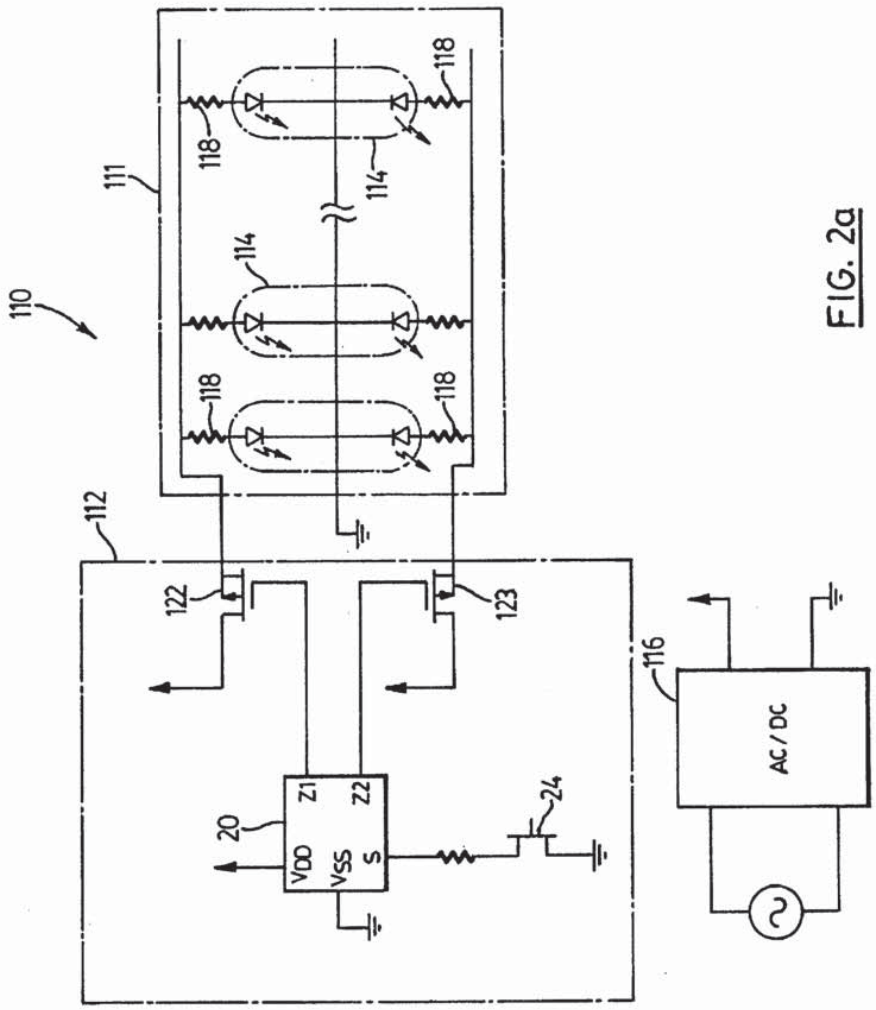


FIG. 2a

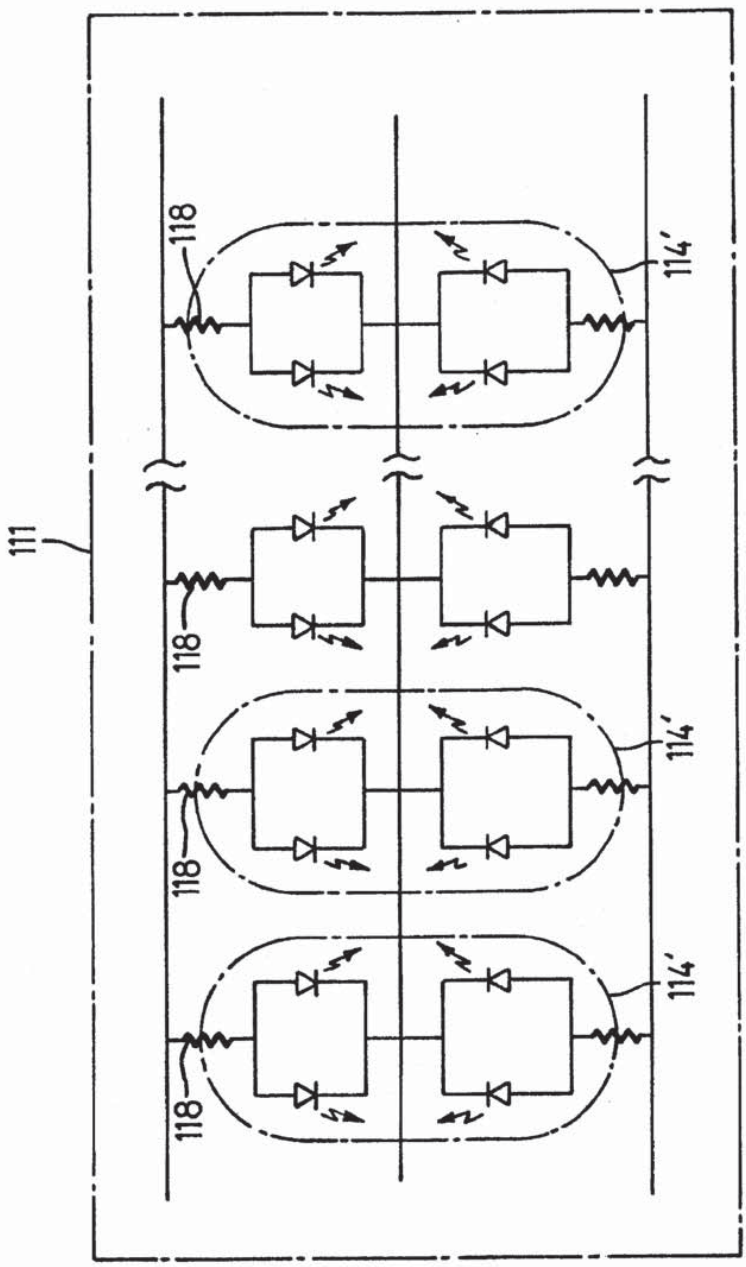


FIG. 2b

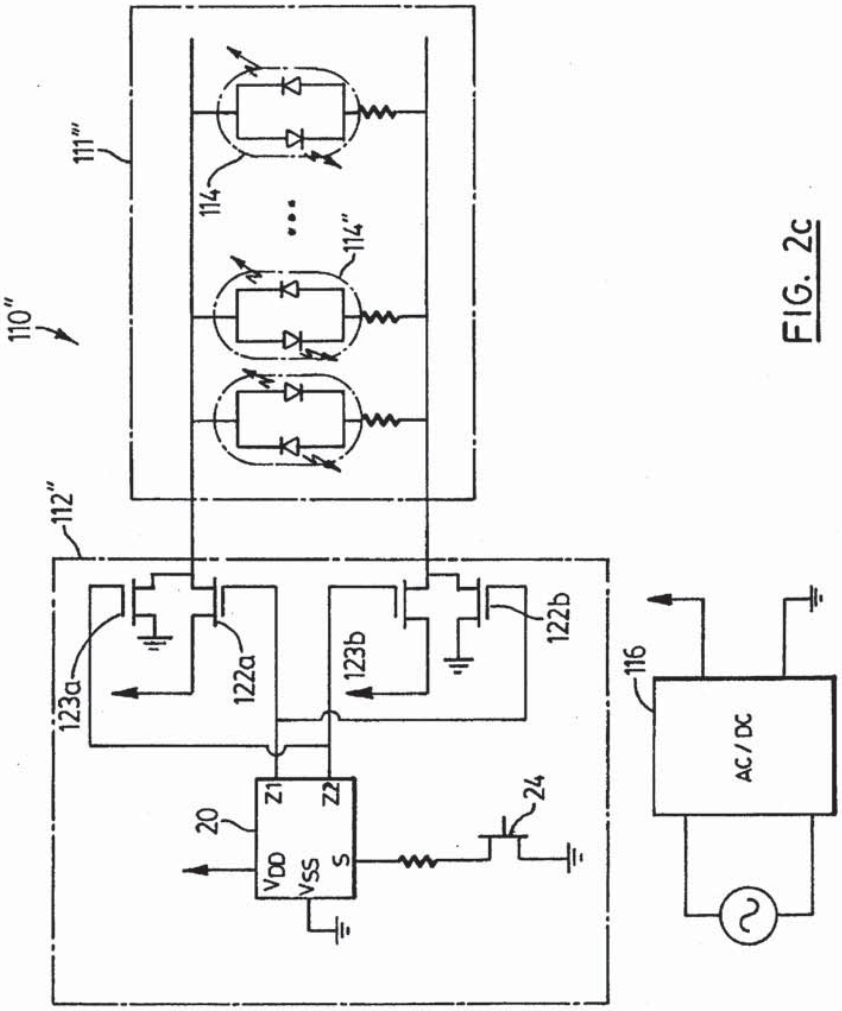

110"
111"
112"
114
114"
123a
122a
123b
122b
116
AC/DC
20
Z1
Z2
VDD
VSS
S
24

FIG. 2c

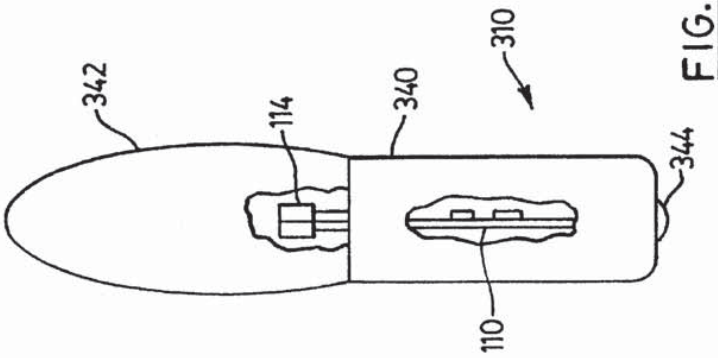

342
114
340
310
344
110

FIG. 4

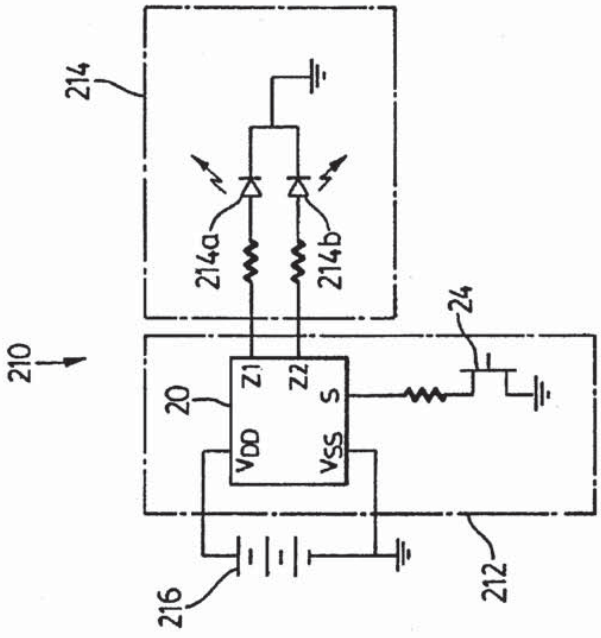

214
214a
214b
210
20
Z1
Z2
S
VDD
VSS
24
216
212

FIG. 3

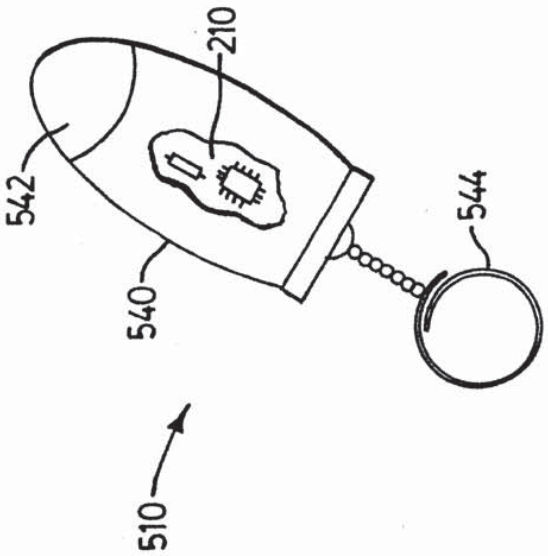


FIG. 5b

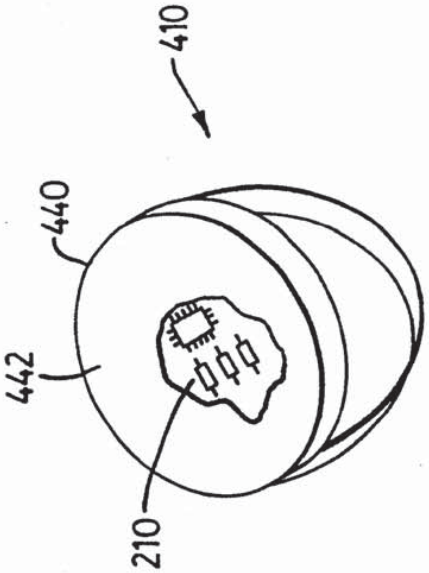


FIG. 5a

VARIABLE-EFFECT LIGHTING SYSTEM

FIELD OF THE INVENTION

The present invention relates to variable-effect lighting systems. In particular, the present invention relates to a lighting system having coloured lamps for producing a myriad of colour displays.

BACKGROUND OF THE INVENTION

Variable-effect lighting systems are commonly used for advertising, decoration, and ornamental or festive displays. Such lighting systems frequently include a set of coloured lamps packaged in a common fixture, and a control system which controls the output intensity of each lamp in order to control the colour of light emanating from the fixture.

For instance, Kunins (U.S. Pat. No. 2,515,236) teaches a coloured light source comprising a fixture having a red lamp, a green lamp, and blue lamp, with each lamp being connected to separate output terminal of an autotransformer. The autotransformer is connected to an AC voltage source, and the core of the autotransformer is rotated by a motor so as to vary the voltage applied to each lamp and thereby control the colour of light emanating from the fixture. Although the light source taught by Kunins may be suitable for producing light of varying colour, the use of a motor and autotransformer is bulky and is not suitable for producing intricate colour displays.

More recently, multi-coloured light-emitting diodes (LEDs) have been used with electronic switches to improve the versatility of the lighting system. For instance, Kazar (U.S. Pat. No. 5,008,595) teaches a light display comprising strings of bicoloured LED packages connected in parallel across a common DC voltage source. Each bicoloured LED package comprises a pair of red and green LEDs, connected back-to-back, with the bicoloured LED packages in each string being connected in parallel to the voltage source through an H-bridge circuit. A control circuit, connected to the H-bridge circuits, allows the red and green LEDS to conduct each alternate half cycle, with the conduction angle each half cycle being determined according to a modulating input source coupled to the control circuit. As a result, the bicolour LEDS can be forced to illuminate continuously, or to flash. Further, the colour of light produced by each bicolour LED can be continuously varied between two extremes.

Although the light display taught by Kazar offers an improvement over prior variable-effect lighting systems, the control system and the H-bridge circuitry increases the complexity of the lighting system. Further, the rate of change of coloured light produced is restricted by the modulating input source. Therefore, the range of colour displays which can be produced by the light display is limited.

Phares (U.S. Pat. No. 5,420,482) teaches a controlled lighting system which allows a greater range of colour displays to be realized. The lighting system comprises a control system which transmits illumination data to a number of lighting modules. Each lighting module includes at least two lamps and a control unit connected to the lamps and responsive to the illumination data to individually vary the amount of light emitted from each lamp. However, the illumination data only controls the brightness of each lamp at any given instant. Therefore, the lighting system is not particularly well suited to easily producing intricate colour displays.

Murad (U.S. Pat. No. 4,317.071) teaches a computerized illumination system for producing a continuous variation in output colour. The illumination system comprises a number of different coloured lamps, a low frequency clock, and a control circuit connected to the low frequency clock and to each coloured lamp for varying the intensity of light produced by each lamp. However, the rate of change of lamp intensity is dictated by the frequency of the low frequency clock, and the range of colour displays is limited.

Accordingly, there remains a need for a relatively simple variable-effect lighting system which allows for greater variation in the range of colour displays which can be realized.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a variable-effect lighting system which addresses the deficiencies of the prior art lighting systems.

The variable-effect lighting system, according to the invention, comprises a lamp assembly, and a programmable lamp controller. The lamp assembly includes a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light. The programmable lamp controller is coupled to the lamp assembly for setting the conduction angle of the illuminating elements according to at least one predetermined pattern stored in a memory of the lamp controller. Preferably, the controller includes a user-operable input to allow the user to select the predetermined pattern and hence the colour display as desired. Alternately, the controller includes a temperature sensor for selecting the predetermined pattern according to ambient temperature, or a clock circuit for selecting the predetermined pattern according to the time.

In one embodiment of the invention, the programable lamp controller comprises a microcontroller for setting the conduction angle according to a plurality of user-selectable predetermined patterns. The lamp assembly comprises a string of series-connected bicoloured light-emitting diodes connected in series between an AC power source and an electronic switch. The electronic switch is coupled to an output of the microcontroller and sets the conduction angle of the illuminating elements of each bicoloured light-emitting diode according to the predetermined pattern selected.

In another embodiment of the invention, the lamp assembly comprises at least one bicoloured light-emitting diode coupled to a DC power source. The first illuminating element of the bicoloured light-emitting diode is coupled to the DC power source through a first electronic switch, and the second illuminating element of the bicoloured light-emitting diode is coupled to the DC power source through a second electronic switch. The electronic switches are each coupled to a respective output of the programmable controller for setting the conduction angles of the illuminating elements.

In yet another embodiment of the invention, the lamp assembly comprises at least one bicoloured light-emitting diode, with each illuminating element of the bicoloured light-emitting diode being driven directly by a respective output of the programmable controller.

Applications of the invention include Christmas tree light strings, temperature-sensitive lights, night lights, jewelry, key chains and decorative lighting displays.

BRIEF DESCRIPTION OF THE DRAWINGS

The preferred embodiments of the invention will now be described, by way of example only, with reference to the drawings, in which:

FIG. **1***a* is a schematic circuit diagram of a variable-effect lighting system according to a first embodiment of the invention, showing a programmable controller, and a lamp assembly comprising a string of series-coupled bicoloured lamps;

FIG. **1***b* is a schematic circuit diagram of one variation of the lamp assembly shown in FIG. **1***a;*

FIG. **1***c* is a schematic circuit diagram of another variation of the lamp assembly shown in FIG. **1***a;*

FIG. **2***a* is a schematic circuit diagram of a variable-effect lighting system according to a second embodiment of the invention, wherein the lamp assembly comprises a string of parallel-coupled bicoloured lamps;

FIG. **2***b* is a schematic circuit diagram of one variation of the lamp assembly shown in FIG. **2***a;*

FIG. **2***c* is a schematic circuit diagram of one variation of the variable-effect lighting system shown in FIG. **2***a;*

FIG. **3** is a schematic circuit diagram of a variable-effect lighting system according to a third embodiment of the invention, wherein the programmable controller directly drives each bicoloured lamp;

FIG. **4** is a night light according to one implementation of the embodiment shown in FIG. **2**;

FIG. **5***a* is a jewelry piece according to one implementation of the embodiment shown in FIG. **3**; and

FIG. **5***b* is a key chain according to another implementation of the embodiment shown in FIG. **3**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning to FIG. **1***a*, a variable-effect lighting system according to a first embodiment of the invention, denoted generally as **10**, is shown comprising a lamp assembly **11**, and a programmable lamp controller **12** coupled to the lamp assembly **11** for setting the colour of light produced by the lamp assembly **11**. Preferably, the lamp assembly **11** comprises string of multi-coloured lamps **14** interconnected with flexible wire conductor to allow the ornamental lighting system **10** to be used as decorative Christmas tree lights. However, the multi-coloured lamps **14** may also be interconnected with substantially rigid wire conductor or affixed to a substantially rigid backing for applications requiring the lamp assembly **11** to have a measure of rigidity.

The multi-coloured lamps **14** are connected in series with each other and with an AC voltage source **16**, and a current-limiting resistor **18**. Typically the AC voltage source **16** comprises the 60 Hz 120 VAC source commonly available. However, other sources of AC voltage may be used without departing from the scope of the invention. As will be appreciated, the series arrangement of the lamps **14** eliminates the need for a step-down transformer between the AC voltage source **16** and the lamp assembly **11**. The current-limiting resistor **18** limits the magnitude of current flowing through the lamps **14**. However, the current-limiting resistor **18** may be eliminated if a sufficient number of lamps **14** are used, or if the magnitude of the voltage produced by the AC voltage source **16** is selected so that the lamps **14** will not be exposed to excessive current flow.

For longevity, each lamp **14** comprises a bicoloured LED having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light which is different from the first colour, and with the leads of each lamp **14** disposed such that when current flows through the lamp **14** in one direction the first colour of light is produced, and when current flows through the lamp **14** in the opposite direction the second colour of light is produced. As shown in FIG. **1***a*, preferably each bicoloured LED comprises a pair of differently-coloured LEDs **14***a*, **14***b* connected back-to-back, with the first illuminating element comprising the LED **14***a* and the second illuminating element comprising the LED **14***b*.

In a preferred implementation of the invention, the first illuminating element produces red light, and the second illuminating element produces green light. However, other LED colours may be used if desired. In addition, both LEDs **14***a*, **14***b* of some of the lamps **14** may be of the same colour if it is desired that some of the lamps **14** vary the intensity of their respective colour outputs only. Further, each lamp **14** may be fitted with a translucent ornamental bulb shaped as a star, or a flower or may have any other aesthetically pleasing shape for added versatility.

The programmable controller **12** comprises a microcontroller **20**, a bidirectional semiconductor switch **22** controlled by an output Z of the microcontroller **20**, and a user-operable switch **24** coupled to an input S of the microcontroller **20** for selecting the colour display desired. In addition, an input X of the microcontroller **20** is coupled to the AC voltage source **16** through a current-limiting resistor **26** for synchronization purposes, as will be described below. The bidirectional switch **22** is positioned in series with the lamps **14**, between the current limiting resistor **18** and ground. In FIG. **1**, the bidirectional switch **22** is shown comprising a triac switch. However, other bidirectional switches, such as IGBTs or back-to-back SCRs, may be used without departing from the scope of the invention.

The programmable controller **12** is powered by a 5-volt DC regulated power supply **28** connected to the AC voltage source **16** which ensures that the microcontroller **20** receives a steady voltage supply for proper operation. However, for added safety, the programmable controller **12** also includes a brownout detector **30** connected to an input Y of the microcontroller **20** for placing the microcontroller **20** in a stable operational mode should the supply voltage to the microcontroller **20** drop below acceptable limits.

The microcontroller **20** includes a non-volatile memory which is programmed or "burned-in" with preferably several conduction angle patterns for setting the conduction angle of the bidirectional switch **22** in accordance with the pattern selected. In this manner, the conduction angles of the LEDs **14***a*, **14***b* (and hence the colour display generated by the bicoloured lamps **14**) can be selected.

Preferred colour displays include, but are not limited to:

1. continuous slow colour change between red, amber and green
2. continuous rapid colour change between red, amber and green
3. continuous alternate flashing of red and green
4. continuous random flashing of red and green
5. continuous illumination of red only
6. continuous change in intensity of red
7. continuous flashing of red only
8. continuous illumination of green only
9. continuous change in intensity of green
10. continuous flashing of green only
11. continuous illumination of red and green to produce amber
12. combination of any of the preceding colour displays

However, as will be appreciated, the microcontroller **20** need only be programmed with a single conduction angle

pattern to function. Further, the microcontroller **20** needs only to be programmed in situ with a user interface (not shown) for increased flexibility. As will be apparent, if the microcontroller **20** is programmed with only a single conduction angle pattern, the user-operable switch **24** may be eliminated from the programmable controller **12**. Further, the user-operable switch **24** may be eliminated even when the microcontroller **20** is programmed with a number of conduction angle patterns, with the microcontroller **20** automatically switching between the various conduction angle patterns. Alternately, the user-operable switch **24** may be replaced with a clock circuit which signals the microcontroller **20** to switch conduction angle patterns according to the time.

The operation of the variable-effect lighting system **10** will now be described. Prior to power-up of the lighting system **10**, the microcontroller **20** is programmed with at least one conduction angle pattern. Alternately, the microcontroller **20** is programmed after power-up using the above-described user interface. Once power is applied through the AC voltage source **16**, the 5-volt DC regulated power supply **28** provides power to the microcontroller **20** and the brown-out detector **30**.

After the brown-out detector **30** signals the microcontroller **20** at input Y that the voltage supplied by the power supply **28** has reached the threshold sufficient for proper operation of the microcontroller **20**, the microcontroller **20** begins executing instructions for implementing a default conduction angle pattern. However, if a change of state is detected at the input S by reason of the user activating the user-operable switch **24**, the microcontroller **20** will begin executing instructions for implementing the next conduction angle pattern. For instance, if the microcontroller **20** is executing instructions for implementing the third conduction angle pattern identified above, actuation of the user-operable switch **24** will force the microcontroller **20** to being executing instructions for implementing the fourth conduction angle pattern.

For ease of explanation, it is convenient to assume that the LED **14***a* is a red LED, and the LED **14***b* is a green LED. It is also convenient to assume that the first conduction angle pattern, identified above, is selected. The operation of the lighting system **10** for the remaining conduction angle patterns will be readily understood from the following description by those skilled in the art.

After the conduction angle pattern is selected, either by default or by reason of activation of the user-operable switch **24**, the microcontroller **20** will begin monitoring the AC signal received at the input X to the microcontroller **20**. Once a positive-going zero-crossing of the AC voltage source **16** is detected, the microcontroller **20** delays a predetermined period. After the predetermined period has elapsed, the microcontroller **20** issues a pulse to the bidirectional switch **22**, causing the bidirectional switch **22** to conduct current in the direction denoted by the arrow **32**. As a result, the red LED **14***a* illuminates until the next zero-crossing of the AC voltage source **16**. In addition, while the LED **14***a* is conducting current, the predetermined period for the LED **14***a* is increased in preparation for the next positive-going zero-crossing of the AC voltage source **16**.

After the negative-going zero-crossing of the AC signal source **16** is detected at the input X, the microcontroller **20** again delays a predetermined period. After the predetermined period has elapsed, the microcontroller **20** issues a pulse to the bidirectional switch **22**, causing the bidirectional switch **22** to conduct current in the direction denoted by the arrow **34**. As a result, the green LED **14***b* illuminates until the next zero-crossing of the AC voltage source **16**. In addition, while the LED **14***b* is conducting current, the predetermined period for the LED **14***b* is decreased in preparation for the next negative-going zero-crossing of the AC voltage source **16**.

With the above conduction angle sequence, it will be apparent that the period of time each cycle during which the red LED **14***a* illuminates will continually decrease, while the period of time each cycle during which the green LED **14***b* illuminates will continually increase. Therefore, the colour of light emanating from the bicoloured lamps **14** will gradually change from red, to amber, to green, with the colour of light emanating from the lamps **14** when both the LEDs **14***a*, **14***b* are conducting being determined by the instantaneous ratio of the magnitude of the conduction angle of the LED **14***a* to the magnitude of the conduction angle of the LED **14***b*.

When the conduction angle of the green LED **14***b* reaches 180°, the conduction angle pattern is reversed so that the colour of light emanating from the bicoloured lamps **14** changes from green, to amber and back to red. As will be appreciated, the maximum conduction angles for each conducting element of the lamps **14** can be set less than 180° if desired.

In a preferred implementation of the invention, the microcontroller **20** comprises a Microchip PIC12C508 microcontroller. The zero-crossings of the AC voltage source **16** are detected at pin **3**, the state of the user-operable switch **24** is detected at pin **7**, and the bidirectional switch **22** is controlled by pin **6**. The brown-out detector **30** is coupled to pin **4**. The assembly code listing for generating conduction angle patterns **1**,**2** and **3** with the Microchip PIC12C508 microcontroller is shown in Table A.

TABLE A

```
; Constants
    AC_IN EQU 4;       GP4 (pin 3) is AC input pin X
    TRIGGER_OUT EQU 1; GP1 (pin 6) is Triac Trigger pin Z
    BUTTON EQU 0; GP0 (pin 7) is Button 24 input pin S and is active low
    delay_dime EQU 0x007
    dim_val EQU 0x008
    trigger_delay EQU 0x009
    DELAY1 EQU 0x00A
    DELAY2 EQU 0x00B
    DELAY3 EQU 0x00C
    RED_INTENSITY EQU 0x00D
    SUBTRACT_REG EQU 0x00E
    DELAY5 EQU 0x00F
    FLASH_COUNT EQU 0x010
    FLASH_COUNT_SHAD EQU 0x011
```

TABLE A-continued

```
    FADE_DELAY EQU 0x012
    org 0;          RESET vector location
    movwf OSCCAL;   move data from W register to OSCCAL
    goto START
DELAY;          subroutine to delay 83 usec * register W
    movwf dim_val;
LOOP1
    movlw .27
    movwf delay_dim
LOOP2;          delay 83 usec
    decfsz delay_dim,1
    goto LOOP2
    decfsz dim_val,1
    goto LOOP1
return
TRIGGER;        subroutine to send trigger pulse to triac
    bsf GPIO,TRIGGER_OUT
            movlw b'00010001'
            TRIS GPIO;          send trigger to triac
    movlw .30
    movwf trigger_delay
LOOP3
    decfsz trigger_delay,1
    goto LOOP3;             delay 30 usec
            movlw b'00010011'
            TRIS GPIO;  remove trigger from triac
return
DELAY_SEC
    movlw .4
    movwf DELAY3;           set DELAY3
SEC2
    movlw .250
    movwf DELAY2;           set DELAY2
QUART_SEC2
    movlw .250
    movwf DELAY1;           set DELAY1
MSEC2
    clrwdt;     clear Watchdog timer
    decfsz DELAY1,1;        wait DELAY1
    goto MSEC2
    decfsz DELAY2,1;        wait DELAY2 * DELAY1
    goto QUART_SEC2
    decfsz DELAY3,1:        wait DELAY3 * DELAY2 * DELAY1
    goto SEC2
return
FADE_SUB;   subroutine to vary conduction angle for triac each half cycle
UP_LOOP;    increase delay before triac starts to conduct each negative half
            cycle while decreasing delay each positive half cycle
    btfss GPIO,AC_IN
    goto UP_LOOP;           wait for positive swing on AC input
WAIT_NEG1
    call WAIT_NEG_EDGE1;    increase delay before turning triac on each negative
                            half cycle
NO_CHANGE
    movlw .90;              register W = maximum delay value before triac turns on
    subwf RED_INTENSITY,0
    btfsc STATUS,Z
    goto WAIT_NEG2;         if RED_INTENSITY is equal to maximum delay value,
                            start increasing delay value
    movf RED_INTENSITY,0
    btfss GPIO,BUTTON
return;                     return if Button depressed
    call DELAY;             delay RED_INTENSITY * 83 usec
    call TRIGGER;           send trigger pulse to triac
MAIN_LOOP2
    btfsc GPIO,AC_IN
    goto MAIN_LOOP2; wait for negative swing on AC input
WAIT_POS_EDGE1
    btfss GPIO,AC_IN
    goto WAIT_POS_EDGE1;    wait for positive swing on AC input
    movlw .96
    movwf SUBTRACT_REG;         SUBTRACT_REG = maximum delay value
                                + minimum delay value before triac turns on
    movf RED_INTENSITY,0
    subwf SUBTRACT_REG,0
    call DELAY;             delay (SUBTRACT_RED-RED_INTENSITY) * 83 usec
    call TRIGGER;           send trigger pulse to triac
    goto UP_LOOP
DOWN_LOOP
```

TABLE A-continued

```
    btfss GPIO,AC_IN
    goto DOWN_LOOP; wait for positive swing on AC input
WAIT_NEG2
    call WAIT_NEG_EDGE2;      decrease delay before triac turns on each negative
                              half cycle
NO_CHANGE2
    movlw .6
    subwf RED_INTENSITY,0;    register W = RED_INTENSITY - minimum delay
                              value
    btfsc STATUS,Z
    goto WAIT_NEG1;           if RED_INTENSITY is equal to minimum delay
                              value, start increasing delay
    movf RED_INTENSITY,0
    btfss GPIO,BUTTON
return;                       return if Button depressed
    call DELAY;               delay RED_INTENSITY * 83 usec
    call TRIGGER;             send trigger pulse to triac
MAIN_LOOP3
    btfsc GPIO,AC_IN
    goto MAIN_LOOP3; wait for negative swing on AC input
WAIT_POS_EDGE2
    btfss GPIO,AC_IN
    goto WAIT_POS_EDGE2;      wait for positive swing on AC input
    movlw .96
    movwf SUBTRACT_REG;       SUBTRACT_REG = maximum delay value before
                              triac turns on
    movf RED_INTENSITY,0
    subwf SUBTRACT_REG,0
    call DELAY;               delay (SUBTRACT_REG-RED_INTENSITY) * 83 usec
    call TRIGGER;             send trigger pulse to triac
    goto DOWN_LOOP
return
WAIT_NEG_EDGE1;               routine to increase delay before triac turns on each negative
                              half cycle
    btfsc GPIO,AC_IN;         wait for negative swing on AC input
    goto WAIT_NEG_EDGE1
    decfsz DELAY5,1;          DELAY5 = fade delay, ie number of cycles at present delay
                              value; decrement and return if not zero
return
    incf RED_INTENSITY,1;     otherwise, increment delay and return
    movf FADE_DELAY,0
    movwf DELAY5
return
WAIT_NEG_EDGE2;               routine to decrease delay before triac turns on each negative
                              half cycle
    btfsc GPIO,AC_IN;         wait for negative swing on AC input
    goto WAIT_NEG_EDGE2
    decfsz DELAY5,1;          DELAY5 = number of cycles at present delay value;
                              decrement and return if not zero
return
    decf RED_INTENSITY,1;     otherwise decrement delay and return
    movf FADE_DELAY,0
    movwf DELAY5;             DELAY5 = FADE_DELAY
return
FLASH_SUB;                    subroutine to flash lights at speed dictated by value assigned to
                              FLASH_COUNT_SHAD
    movf FLASH_COUNT_SHAD,0
    movwf FLASH_COUNT;        FLASH_COUNT = duration of flash
MAIN_LOOP4
    btfsc CPIO,AC_IN;         wait for negative swing on AC input
    goto MAIN_LOOP4
WAIT_POS_EDGE4
    btfsc GPIO,AC_IN
    goto WAIT_POS_EDGE4;      wait for positive swing on AC input
    movlw .6
    call DELAY
    call TRIGGER;             send trigger pulse to triac
    btfss GPIO,BUTTON
return;                       return if Button pressed
    decfsz FLASH_COUNT
    goto MAIN_LOOP4;          decrement FLASH_COUNT and repeat until zero
    movf FLASH_COUNT_SHAD,0
    movwf FLASH_COUNT;        reset FLASH_COUNT
DOWN_LOOP4
    btfss GPIO,AC_IN;         wait for positive swing on AC input
    goto DOWN_LOOP4
WAIT_NEG_EDGE4
    btfsc GPIO,AC_IN
    goto WAIT_NEG_EDGE4;      wait for negative swing on AC input
```

TABLE A-continued

```
    movlw .6
    call DELAY
    call TRIGGER                send trigger pulse to triac
    btfss GPIO,BUTTON
return;                         return if Button pressed
    decfsz FLASH_COUNT
    goto DOWN_LOOP4;            decrement FLASH_COUNT and repeat until zero
return
START
    movlw b'00010011'
    TRIS GPIO;  set pins GP4 (AC input), GP1 (Triac output to high impedance),
                GP0 (Button as input)
    movlw b'10010111'; enable pullups on GP0, GP1, GP3
OPTION
    movlw .4
    movwf RED_INTENSITY;    load RED_INTENSITY register
    movlw .5
    movwf DELAY5;           set initial fade
FADE_SLOW
    call DELAY_SEC;         wait DELAY3 * DELAY2 * DELAY1
    movlw .5
    movwf FADE_DELAY;       set slow FADE_DELAY
    call FADE_SUB;          slowly fade colours until Button is pressed
    goto FADE_FAST
FADE_FAST
    call DELAY_SEC;         wait DELAY3 * DELAY2 * DELAY1
    movlw .1
    movwf FADE_DELAY;       set fast FADE_DELAY
    call FADE_SUB;          rapidly fade colours until Button is pressed
    goto FLASH2_SEC
FLASH2_SEC ; flash red/green 2 sec interval
    call DELAY_SEC;         wait DELAY3 * DELAY2 * DELAY1
    movlw .120
    movwf FLASH_COUNT_SHAD
FLASH2B_SEC
    btfss GPIO,BUTTON
    goto FLASH1_SEC;        slowly flash lights until Button is pressed
    call FLASH_SUB
    goto FLASH2B_SEC
FLASH1_SEC ; flash red/green 1 sec. interval
    call DELAY_SEC;         wait DELAY3 * DELAY2 * DELAY1
    movlw .60
    movwf FLASH_COUNT_SHAD
FLASH1B_SEC
    btfss GPIO,BUTTON
    goto FLASH_FAST;        flash lights at moderate speed until Button in pressed
    call FLASH_SUB
    goto FLASH1B_SEC
FLASH_FAST ; flash red/green 0.25 sec. interval
    call DELAY_SEC;         wait DELAY3 * DELAY2 * DELAY1
    movlw .15
    movwf FLASH_COUNT_SHAD
FLASH_FASTB
    btfss GPIO,BUTTON
    goto FADE_SLOW;         rapidly flash lights until Button is pressed
    call FLASH_SUB;         slowly fade colours if Button is pressed
    goto FLASH_FASTB
end
```

Numerous variations of the lighting system **10** are possible. In one variation (not shown), the user-operable switch **24** is replaced with a temperature sensor coupled to the input S of the microcontroller **20** for varying the conduction angle pattern according to the ambient temperature. Alternately, the programmable lamp controller **12** includes a plurality of temperature sensors, each being sensitive to a different temperature range, and being coupled to a respective input of the microcontroller **20**. With these variations, one colour display is produced when the ambient temperature falls within one range and another colour display is produced when the ambient temperature falls within a different range.

In another variation (not shown), each lamp **14** comprises a pair of LEDs with one of the LEDs being capable of emitting white light and with the other of the LEDs being capable of producing a colour of light other than white. In still another variation, each lamp **14** comprises a LED capable of producing three or more different colours of light, while in the variation shown in FIG. **1***b*, each lamp **14** comprises three or more differently-coloured LEDs. In these latter two variations, the LEDs are connected such that when current flows in one direction one colour of light is produced, and when current flows in the opposite direction another colour of light is produced.

In yet another variation, shown in FIG. **1***c*, the programmable lamp controller **12** comprises two bidirectional switches **22***a*, **22***b* each connected to a respective output **21**, Z2 of the microcontroller **20**. The lamp assembly **11** comprises first and second strings **11***a*, **11***b* of series-connected back-to-back-coupled LEDs **14***a*, **14***b*, with each string **11***a*, **11***b* being connected to the AC voltage source **16** and to a respective one of the bidirectional switches **22***a*, **22***b*. In this

variation, each multi-coloured lamp **14** comprises one pair of the back-to-back-coupled LEDs **14***a*, **14***b* of the first string **11***a* and one pair of the back-to-back-coupled LEDs **14***a*, **14***b* of the second string **11***b*, with the LEDs of each lamp **14** being inserted in a respective translucent ornamental bulb. As a result, the colour of light emanating from each bulb depends on the instantaneous ratio of the conduction angles of the LEDs **14***a*, **14***b* in both strings **11***a*, **11***b*. Preferably, the outputs **Z1**, **Z2** are independently operable to increase the range of colour displays.

In a further variation, the programmable lamp controller **12** is similar to the programmable lamp controller **12** shown in FIG. **1***c*, in that it comprises two bidirectional switches **22***a*, **22***b* each connected to a respective independently-operable output Z1, Z2 of the microcontroller **20**. However, unlike the programmable lamp controller **12** shown in FIG. **1***c*, the lamp assembly **11** comprises first and second strings **11***a*, **11***b* of series-connected singly-coloured lamps **14**. As above, each singly-coloured lamp **14** of the first string **11***a* is associated with a singly-coloured lamp **14** of the second string **11***b*, with each associated lamp pair being inserted in a respective translucent ornamental bulb. Turning to FIG. **2***a*, a variable-effect lighting system according to a second embodiment of the invention, denoted generally as **110**, is shown comprising a lamp assembly **111**, and a programmable lamp controller **112** coupled to the lamp assembly **111** for setting the colour of light produced by the lamp assembly **111**.

The lamp assembly **111** comprises a string of multi-coloured lamps **114** connected in parallel with each other. The multi-coloured lamps **114** are also connected in parallel with an AC/DC converter **116** which is coupled to an AC voltage source. Each lamp **114** comprises a bicoloured LED having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light which is different from the first colour, with the leads of each lamp **114** configured such that when current flows through one lead the first colour of light is produced, and when current flows through the another lead the second colour of light is produced. As shown in FIG. **2***a*, preferably each bicoloured LED comprises first and second differently-coloured LEDs **114***a*, **114***b* in series with a respective current-limiting resistor **118**, with the common cathode of the LEDs **114** being connected to ground, and with the first illuminating element comprising the first LED **114***a* and the second illuminating element comprising the second LED **114***b*.

The AC/DC converter **116** produces a DC output voltage of a magnitude which is sufficient to power the lamps **114**, but which will not damage the lamps **114**. Typically, the AC/DC converter **116** receives 120 volts AC at its input and produces an output voltage of about 5 volts DC.

The programmable controller **112** is also powered by the output of the AC/DC converter **116** and comprises a microcontroller **20**, a first semiconductor switch **122** controlled by an output Z1 of the microcontroller **20**, a second semiconductor switch **123** controlled by an output Z2 of the microcontroller **20**, and a user-operable switch **24** coupled to an input S of the microcontroller **20** for selecting the colour display desired. As discussed above, the user-operable switch **24** may be eliminated if desired. In FIG. **2***a*, the semiconductor switches **122**, **123** are shown comprising MOSFET switches. However, other semiconductor switches may be used without departing from the scope of the invention.

The first semiconductor switch **122** is connected between the output of the AC/DC converter **116** and the anode of the first LED **114***a* (through the first current-limiting resistor **118**), while the second semiconductor switch **123** is connected between the output of the AC/DC converter **116** and the anode of the second LED **114***b* (through the second current-limiting resistor **118**). However, the anodes of the LEDs **114***a*, **114***b* may be coupled instead to the output of the AC/DC converter, with the first and second semiconductor switches **122**, **123** being connected between the respective cathodes and ground. Other variations on the placement of the semiconductor switches **122**, **123** will be apparent to those skilled in the art.

As with the previously described embodiment, the microcontroller **20** includes a non-volatile memory which is programmed with preferably several conduction angle sequences for setting the firing angle of the semiconductor switches **122**, **123** in accordance with the sequence selected. In this manner, the conduction angles of the LEDs **114***a*, **114***b*, and hence the ultimate colour display generated by the lamps **114** can be selected.

The operation of the variable-effect lighting system **110** is similar to the operation of the variable-effect lighting system **10**. After power is applied to the AC/DC converter **116**, the microcontroller **20** begins executing instructions for implementing one of the conduction angle sequences. Again, assuming that the first conduction angle sequence, identified above, is selected, the microcontroller **20** issues a signal to the first semiconductor switch **122**, causing the first LED **114***a* to illuminate. After a predetermined period has elapsed, the signal to the first semiconductor switch **122** is removed, causing the first LED **114***a* to extinguish. While the LED **114***a* is conducting current, the predetermined period for the first LED **114***a* is decreased in preparation for the next cycle.

The microcontroller **20** then issues a signal to the second semiconductor switch **123**, causing the second LED **114***b* to illuminate. After a predetermined period has elapsed, the signal to the second semiconductor switch **123** is removed, causing the second LED **114***b* to extinguish. While the second LED **114***b* is conducting current, the predetermined period for the second LED **114***b* is increased in preparation for the next cycle.

With the above conduction angle sequence, it will be apparent that the period of time each cycle during which the first LED **114***a* illuminates will continually decrease, while the period of time each cycle during which the second LED **114***b* illuminates will continually increase. Therefore, the colour of light emanating from the lamps **114** will gradually change from the colour of the first LED **114***a* to the colour of the second LED **114***b*, with the colour of light emanating from the lamps **114** when both the LEDs **114***a*, **114***b* are conducting being determined by the instantaneous ratio of the magnitude of the conduction period of the first LED **114***a* to the magnitude of the conduction period of the second LED **114***b*.

Numerous variations of the lighting system **110** are also possible. In one variation, each lamp **114** comprises a pair of LEDs with one of the LEDs being capable of emitting white light and with the other of the LEDs being capable of producing a colour of light other than white. In another variation, each lamp **114** comprises a LED capable of producing three or more different colours of light, while in the variation shown in FIG. **2***b*, each lamp **114** comprises three or more differently-coloured LEDs. In these latter two variations, the LEDs are connected such that when current flows through one of the semiconductor switches one colour of light is produced, and when current flows through the other of the semiconductor switches another colour of light

is produced. In yet another variation, shown in FIG. **2***c*, the programmable controller **112** includes a first pair of electronic switches **122***a*, **122***b* driven by the output Z1 of the microcontroller **20**, and a second pair of electronic switches **123***a*, **123***b* driven by the output Z1 of the microcontroller **20**. Each pair of first and second LEDs **114***a*, **114***b* of each lamp **114** are connected back-to-back, such that the lamps **114** and the semiconductor switches **122**, **123** are configured together as an H-bridge. As discussed above, preferably the first and second LEDs **114***a*, **114***b* produce different colours, although the invention is not intended to be so limited.

Turning to FIG. **3**, a variable-effect lighting system according to a third embodiment of the invention, denoted generally as **210**, is shown comprising a multi-coloured lamp **214**, and a programmable lamp controller **212** coupled to the multi-coloured lamp **214** for setting the colour of light produced by the lamp **214**. The multi-coloured lamp **114** comprises a bicoloured LED having a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light which is different from the first colour. As shown in FIG. **3**, preferably the first illuminating element comprises a red-coloured LED **214***a*, and the second illuminating element comprises a green-coloured LED **214***b*, with the common cathode of the LEDs **214***a*, **214***b* being connected to ground. As discussed above, multi-coloured LEDs and/or arrangements of differently-coloured discrete LEDs and/or translucent ornamental bulbs may be used if desired.

The programmable controller **212** is powered by a 9-volt battery **216**, and comprises a microcontroller **20**, and a user-operable switch **24** coupled to an input S of the microcontroller **20** for selecting the colour display desired. Alternately, for applications where space is at a premium, the programmable controller **212** may be powered by a smaller battery producing a smaller voltage. If necessary, the smaller battery may be coupled to the programmable controller **212** through a voltage amplifier, such as a DC-to-DC converter. As discussed above, the user-operable switch **24** may also be eliminated if desired.

An output Z1 of the microcontroller **20** is connected to the anode of the red LED **214***a*, and an output Z2 of the microcontroller **20** is connected to the anode of the green LED **214***b*. Since the lamp **214** is driven directly by the microcontroller **20**, the variable-colour ornamental lighting system **210** is limited to applications requiring only a small number of lamps **214**.

The operation of the variable-effect lighting system **210** will be readily apparent from the foregoing discussion and, therefore, need not be described.

Turning now to FIG. **4**, a night light **310** is shown comprising the variable-effect lighting system **110**, described above, but including only a single multi-coloured lamp **114**, a housing **340** enclosing the programmable controller **112** and the AC/DC converter **116**, and a translucent bulb **342** covering the lamp **114** and fastened to the housing **340**. Preferably, the housing **340** also includes an ambient light sensor **344** connected to the microcontroller **20** for inhibiting conduction of the lamp **114** when the intensity of ambient light exceeds a threshold.

In FIG. **5***a*, a jewelry piece **410**, shaped as a ring, is shown comprising the variable-effect lighting system **210**, described above, and a housing **440** retaining the lamp **214**, the programmable controller **212**, and the battery **216** therein. A portion **442** of the housing **440** is translucent to allow light to be emitted from the lamp **214**. In FIG. **5***a*, a key chain **510**, is shown comprising the variable-colour ornamental lighting system **210**, and a housing **540** retaining the lamp **214**, the programmable controller **212**, and the battery **216** therein. A portion **542** of the housing **540** is translucent to allow light to be emitted from the lamp **214**. A key clasp **544** is coupled to the housing **540** to retain keys. Both the jewelry piece **410** and the key chain **510** may optionally include a user-operable input for selecting the conduction angle pattern.

The foregoing description of the preferred embodiments is intended to be illustrative of the present invention. Those of ordinary skill will be able to envision certain additions, deletions and/or modifications to the described embodiments without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. A variable-effect lighting system comprising:

a lamp assembly comprising a plurality of multi-coloured lamps in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour; and

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element.

2. The lighting system according to claim **1**, wherein the at least one pattern is selectable according to a user-operable input to the controller.

3. The lighting system according to claim **1**, wherein the lamp controller includes a temperature sensor for selecting the at least one pattern.

4. The lighting system according to claim **1**, wherein each said multi-coloured lamp comprises a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the light-emitting diode comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

5. The lighting system according to claim **4**, wherein the first and second electronic switches form an H-bridge.

6. A night light comprising:

a lamp assembly comprising at least one multi-coloured lamp in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element; and

an AC/DC converter providing the DC voltage source.

7. The night light according to claim **6**, wherein each said predetermined pattern is selectable according to a user-operable input to the controller.

8. The night light according to claim **6**, wherein each said multi-coloured lamp comprises a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the

light-emitting diode comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

9. The night light according to claim **6**, wherein the controller includes an ambient light sensor for inhibiting conduction of the illuminating elements when an intensity of ambient light exceeds a threshold.

10. A jewelry piece comprising:

a lamp assembly comprising at least one multi-coloured lamp in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element; and

a DC power source for powering the lamp assembly and the controller.

11. The jewelry piece according to claim **10**, wherein each said predetermined pattern is selectable according to a user-operable input to the controller.

12. The jewelry piece according to claim **10**, wherein the lamp controller includes a temperature sensor for selecting the at least one pattern.

13. The jewelry piece according to claim **10**, wherein each said multi-coloured lamp comprises a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the light-emitting diode comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

14. A key chain comprising:

a lamp assembly comprising at least one multi-coloured lamp in parallel with a DC voltage source, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light, and a second illuminating element for producing a second colour of light different from the first colour;

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller, the lamp controller including a first electronic switch coupled to the first illuminating element and a second electronic switch coupled to the second illuminating element;

a DC power source for powering the lamp assembly and the controller;

a housing retaining the lamp assembly, the controller and the power source therein; and

retaining means coupled to the housing for retaining keys therein.

15. The key chain according to claim **14**, wherein each said predetermined pattern is selectable according to a user-operable input to the controller.

16. The key chain according to claim **14**, wherein the lamp controller includes a temperature sensor for selecting the at least one pattern.

17. The key chain according to claim **14**, wherein each said multi-coloured lamp comprises a pair of commonly-coupled light-emitting diodes, a first light-emitting diode of the light-emitting diode comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

18. A variable-effect lighting system comprising:

a lamp assembly comprising a plurality of multi-coloured lamps in series with an AC voltage source and in series with each other, the AC voltage source having a first voltage phase and a second voltage phase opposite the first phase, each said multi-coloured lamp comprising a first illuminating element for producing a first colour of light during the first voltage phase, and a second illuminating element for producing a second colour of light different from the first colour during the second voltage phase; and

a programmable lamp controller coupled to the lamp assembly for setting a conduction angle of each said illuminating element according to at least one predetermined pattern, each said predetermined pattern being stored in a memory of the controller.

19. The lighting system according to claim **18**, wherein each said multi-coloured lamp comprises a pair of light-emitting diodes connected back-to-back, a first light-emitting diode of the light-emitting diode comprising the first illuminating element and a second light-emitting diode of the light-emitting diode pair comprising the second illuminating element.

20. The lighting system according to claim **18**, wherein the at least one pattern is selectable according to a user-operable input to the controller.

21. The lighting system according to claim **18**, wherein the lamp controller includes an ambient temperature sensor for selecting the at least one pattern.

* * * * *