

[54] DECORATIVE LIGHTING SYSTEM

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340/331

[51] Int. Cl. H05b 37/02

[58] Field of Search. 240/10 R, 10 T; 315/194, 195,
315/250, 291, 294, 297, 307; 40/130 R, 130
C; 340/331, 334, 335, 340, 341

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Primary Examiner—Joseph F. Peters, Jr.

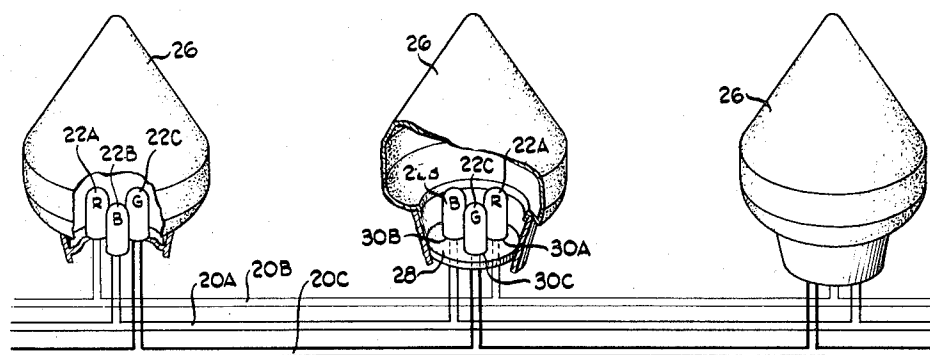
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[57]

ABSTRACT

A multi-channel lighting system which includes a lamp load for each channel. Each channel is a nominally identical self-modulating half-wave phase control circuit employing DC feedback to modify both reference and pedestal levels in a dual frequency oscillator. The result is a random off and on pattern for each channel. Each lamp load is a different color which produces a random and dynamic color light display in response to each channel for decorating Christmas trees or the like.

13 Claims, 9 Drawing Figures



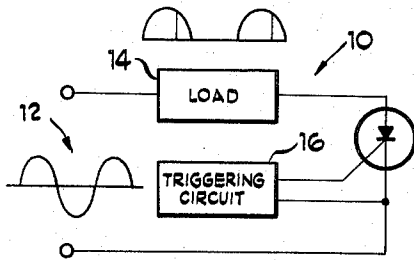


Fig 1

Fig 3

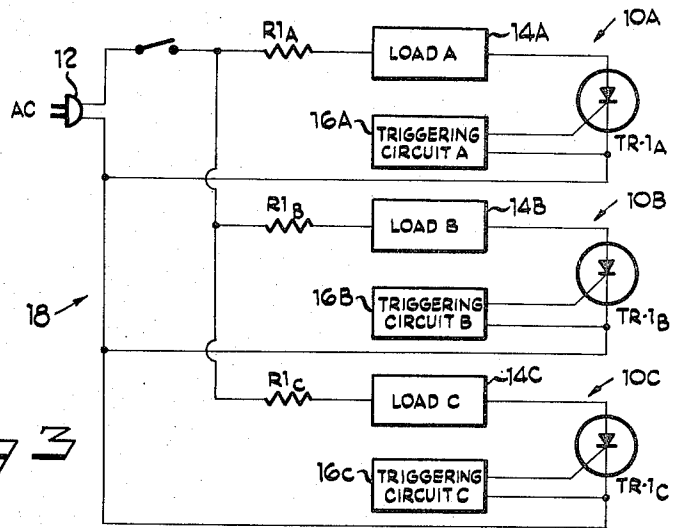


Fig 2

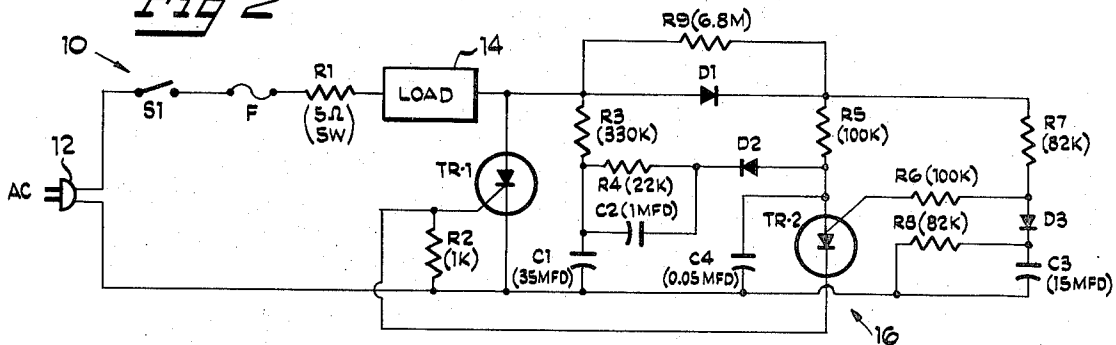


Fig 4

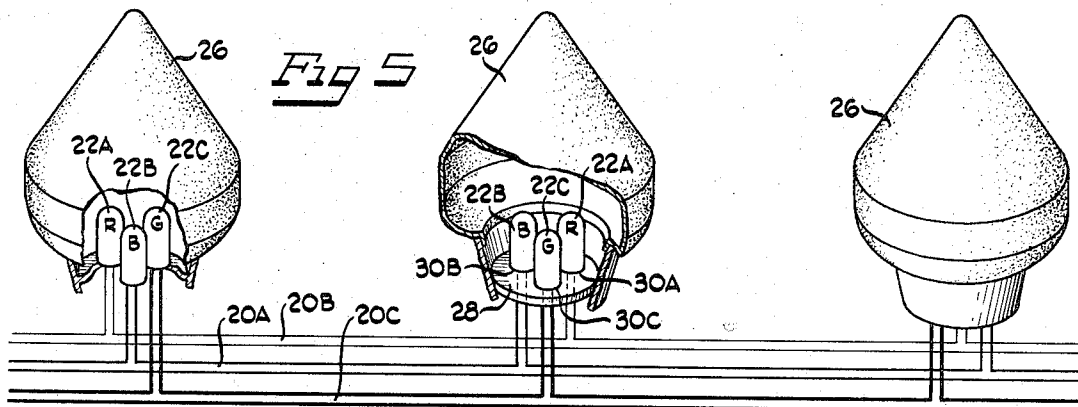
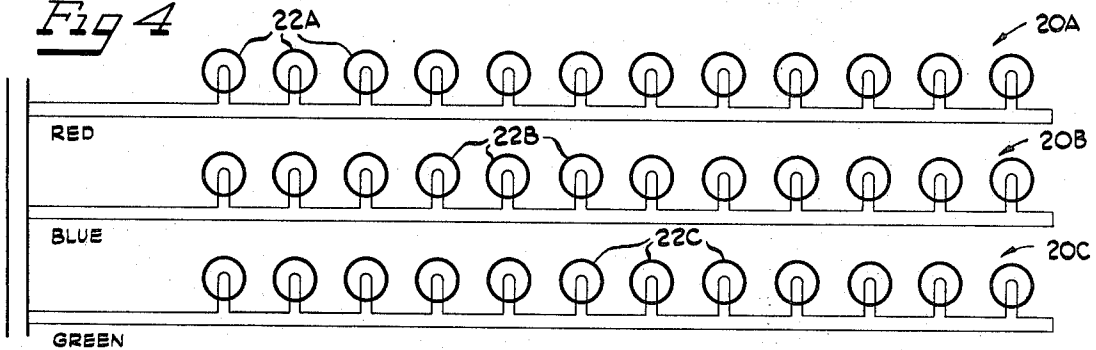


Fig 6

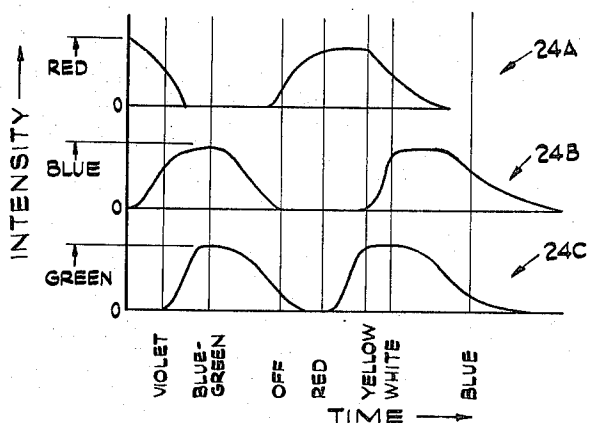


Fig 7

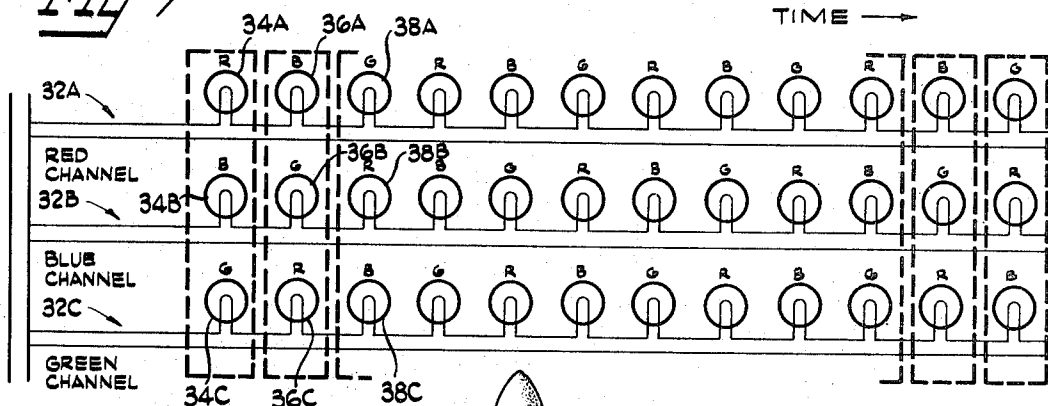


Fig 8

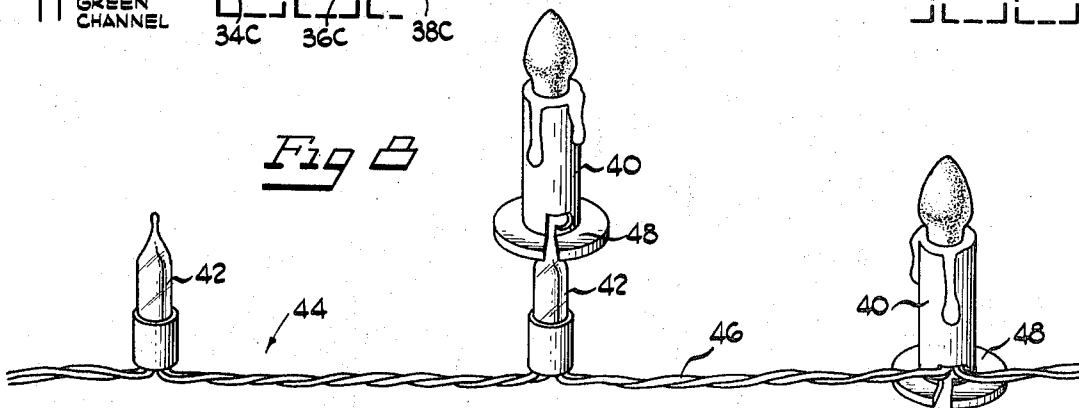
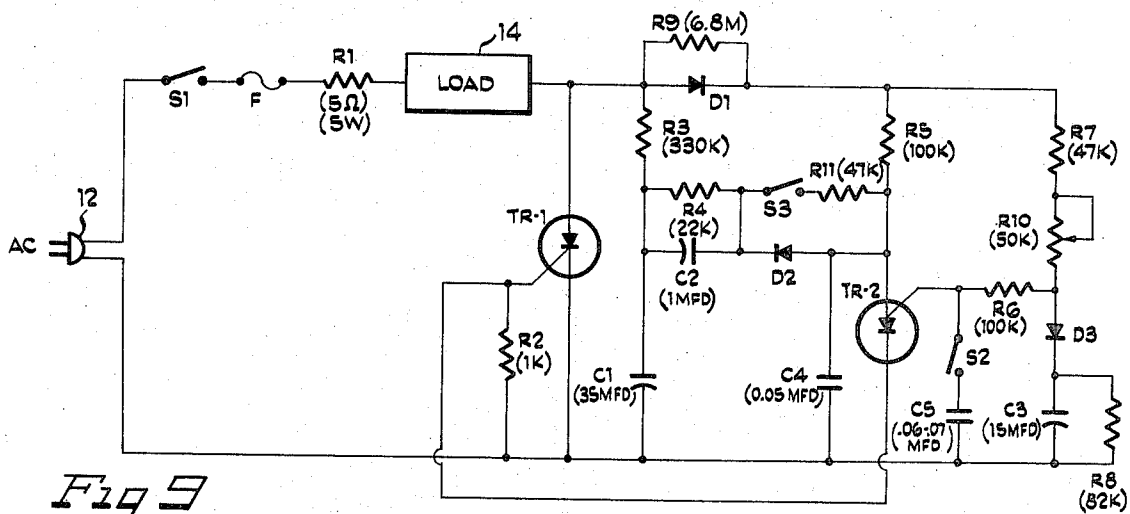


Fig 9



DECORATIVE LIGHTING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to decorative electric lighting systems.

2. Description of the Prior Art

With the advent of new advances in the electronics field, decorative lighting in recent years has taken on greater sophistication. It is well known in the art to provide flashing lights which are connected to electrical circuitry. Most of the circuitry has been of the type which give the lights connected to it a non-random flashing characteristic. An example of circuitry which will exhibit random characteristics is the self-modulating half-wave phase control circuit shown in General Electric Application Note No. 671.18 (Mar. 1969) at page 6. However, lighting systems have not employed this type of circuitry to produce a dynamically changing colored light display for decorations.

SUMMARY OF THE INVENTION

The principal object of this invention is to provide a decorative lighting system for use in association with a Christmas tree or the like. The lighting system will produce randomly changing intensity levels of light or lights which blend to display dynamically changing colored lights. Another object is to provide a lighting system which simulates the flickering of a candle in the breeze.

These and other objects are accomplished in one form of the invention currently contemplated by providing an electrical power source, multi-channel control means connected to the power source and a lamp load connected to each channel. The control means controls the power through each of the channels in an independent and random fashion between on and off. Each lamp load is caused to slowly increase or decrease in intensity between on and off in response to its respective channel. The control means is in the form of a three channelled self-modulating half-wave phase control circuit wherein each of the lamp loads exhibit a different color, the three colors being red, blue and green.

In an embodiment of the invention, the lamp loads are in the form of three strings of colored lightbulbs, each string connected to a channel of the control circuit. An ornament in the form of a translucent enclosure is adapted to house three bulbs, one from each string. The three bulbs in the ornament are colored red, blue and green. The ornament displays a gradual dynamically changing mono-color light in response to the control circuit.

Another embodiment of the present invention is the addition of an electrical component to the control circuit which causes a lamp load to flicker when triggered on. The effect is that of a candle flickering in a gentle breeze.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of a single channel circuit comprising part of the system of the invention;

FIG. 2 is a more detailed schematic diagram of the circuit shown in FIG. 1;

FIG. 3 is a schematic diagram of a three channel circuit comprising part of the invention;

FIG. 4 is a schematic diagram of the load to be connected to the circuit shown in FIG. 3;

FIG. 5 is a fragmented perspective view of a portion of a string of ornaments to be connected to the circuit shown in FIG. 3;

FIG. 6 is a graphic representation of the intensity of the lamp load of the circuit shown in FIG. 3 versus time;

FIG. 7 is a schematic diagram of another load which can be connected to the circuit shown in FIG. 3;

FIG. 8 is a fragmented perspective view of a portion of another string of ornaments; and

FIG. 9 is a schematic diagram of a modification to the circuit shown in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

I. SINGLE CHANNEL PHASE CONTROL CIRCUIT

FIGS. 1 and 2 show a single channel phase control circuit which comprises a part of the instant invention. Specifically, FIG. 1 illustrates a simplified half-wave phase control circuit, generally designated 10, including an AC source 12, a load 14 in the form of a lamp which gives off light when conducting current, a silicon controlled rectifier (SCR), TR-1, and a triggering circuit 16. Phase control is the rapid on-off switching which connects the load to the AC source for a controlled fraction of each cycle by governing the phase angle of the AC wave at which the circuit is allowed to conduct current. The result in such a circuit is a lamp load 14 which is controlled in intensity.

The phase control in the circuit shown in FIG. 1 is effected by the interaction of the SCR, TR-1, and the triggering circuit 16. The SCR controls current in one direction only. Thus, the SCR, TR-1, is capable of supplying current or power to the load lamp 14 in the circuit during every positive half cycle.

The time period in which the SCR conducts during each half cycle depends on the phase angle of the AC wave when the SCR is fired, which is determined by the triggering circuit 16. After the SCR, TR-1, is fired in response to the triggering circuit 16, current will be conducted through the lamp load 14 causing excitation thereof for the remainder of that particular half-cycle.

Turning now to FIG. 2, a complete detailed schematic diagram of the circuit illustrated in FIG. 1 is shown. In essence, the circuit shown in FIG. 2 is a self-modulating half-wave phase control circuit employing DC feedback to modify both reference and pedestal levels in the triggering circuit.

The triggering circuit is seen to be a dual frequency oscillator having two notably different time constants which causes the triggering angle to be swept slowly back and forth across the 10° to 170° range which is dark to half bright as far as a light intensity is concerned.

A programmable unijunction transistor (PUT), TR-2, is arranged in the triggering circuit to fire TR-1. The PUT, TR-2, can also be thought of as a complementary SCR. When the gate voltage of TR-2 drops below the anode voltage current flows from anode to cathode hence phase firing the SCR, TR-1.

In operation, when the circuit in FIG. 2 is first turned on, C1 and C3 have no charge on them. Capacitor C4 quickly charges up to a voltage greater than the gate voltage of TR-2. When this occurs, TR-2 is triggered on which fires TR-1 causing the load lamp 14 to come on

brightly. On each succeeding cycle of operation, capacitors C1 and C3 have a higher initial charge on them so that C4 cannot charge to a voltage which would trigger TR-2 until much later in the cycle. Since C3 charges at a faster rate through R7 than C1 and through R3, R4 and R5 the lamp dims slowly. When the lamp extinguishes, C1 discharges faster than C3 and the triggering angle of TR-1 is advanced and the load lamp once again brightens. In this manner, the load lamp is caused to vary slowly through the range of 160° between off and half bright.

The purpose of R1 and the fuse F in the circuit is strictly for the protection of TR-1, the SCR. Resistor R1 keeps the peak current through the SCR within its maximum ratings in the event of a shorted load as in the case of a lamp burnout.

II. THREE CHANNEL PHASE CONTROL SYSTEM

FIG. 3 shows a multi-channel phase control system, generally designated 18, having three channels, generally designated 10A, 10B and 10C. Each channel comprises the identical half-wave phase control circuit 10 shown in FIGS. 1 and 2 and described above. The three channels have the same components and are connected in parallel across the AC source 12.

The respective lamp loads, 14A, 14B and 14C, of this system 18 comprise three strings of parallel or series connected Christmas tree lights 20A, B and C having a plurality of individual lightbulbs 22 as shown in FIG. 4. The only difference between each of the three strings of light 20 is their color. Load 14A consists of a red colored string of lightbulbs 22A, load 14B consists of a blue colored string of lightbulbs 22B and load 14C consists of a green colored string of lightbulbs 22C.

If a Christmas tree is decorated with these strings of lights, 20A, B and C, in the usual manner and power is applied through each of the three channels, 10A, B and C, all the strings of lights will come on at once. However, due to the inherent component differences between each of the channels, 10A, B and C, due to manufacturing tolerances, the excitation of each lamp load, 14A, B and C, will immediately begin to exhibit a true randomness by each channel coming on sooner or staying off a little longer with respect to the other channels. In this way the whole tree will be bathed in slow changing colors causing dynamic reflection on the other decorations on the tree.

The three strings of different colored lights 20A, B and C can be modified somewhat by grouping the corresponding light-bulbs 22 from each string 20 together in close proximity and enclosing the three different colored bulbs within a frosted ornament 26 as shown in FIG. 5 forming one string of ornaments (not shown). The corresponding lightbulbs forming the group are the first bulb of each string, the second bulb of each string, etc. The ornament 26 has a base 28 with three suitably sized openings 30A, 30B and 30C formed therein for receiving the individual lightbulbs 22.

The total number of ornaments 26 in a string would be determined by the number of bulbs 22 on each string of light 20. Each ornament 26 would have three small differently colored bulbs 22 in it and each bulb therein would be part of a series string connected to one of the channels 10A, B and C.

The frosted ornament 26 has the effect of muting and blending the color components of the three differently colored bulbs 22. The effect is to make the color of the

lighted ornament 26 appear to be one color at any given instant in time. However, the resultant monochrome is constantly changing.

To better illustrate the dynamic color concept, FIG. 6 shows three graphs, 24A, 24B and 24C depicting a typical display of intensity versus time for the three channel system 18, each graph corresponding to a channel 10A, B or C. It may be seen that light intensity and the phase firing of each channel are continuously varying with time. The colors blue, red and green are all the colors which are necessary to perceptually make all of the colors of the spectrum. Thus, the excitation of each of the three different colored bulbs 22 in each ornament 26 at different times and at different intensities, takes or adds some of the color components of the respective ornament. This adding or taking away of the color components provides unique blending giving a dynamic random display theoretically covering all the colors of the spectrum.

Each of the three strings of lights 20, as described above, can have alternating colors. For example, as shown in FIG. 7 a string of lights 32A connected to one channel 10 may have the first lightbulb 34A red, the second lightbulb 36A blue, and the third lightbulb 38A green, etc. The second string of lights connected to the second channel in a like manner would have the first lightbulb 34B blue, the second 36B green and the third 38B red, etc. The third string of lights connected to the third channel in the same manner would have the first lightbulb 34C green, the second 36C red and the third 38C blue, etc. In this manner every three lightbulbs in succession of each string 32 repeat the same sequence of color at a given instant in time.

The corresponding lightbulbs on each string of lights 32 (e.g., lights 34 A, B and C) are then enclosed within the frosted ornament 26 as described above. This arrangement then is similar to that described above in that each ornament 26 has three different colored bulbs enclosed therein. The difference is that every third ornament 26 will be the same color at any given instant in time after turning the system on rather than every ornament being the same color.

Because the circuit is half-wave operation, the voltage output can only achieve a maximum of about 50 to 60 volts. Hence, for series connected lamps in a string, the lightbulbs should be chosen with regard to voltage and total number to insure sufficient color output. For example, 25 three-volt lamps would total 75 volts. With a maximum of say 55 volts available this string would have good color purity from each lamp and still be running sufficiently below maximum voltage per lamp to assure very long lamp life. The loads could consist of parallel connected colored lights in a similar manner as long as the total load per channel does not exceed 150 watts nominal. In this manner as many as 25 six-watt colored bulbs could be connected per channel.

Another use of the described three channel system is with a silver tree. Three colored flood lamps each connected to a channel could be placed at the base of the tree causing a very interesting blending of colors far more effective than any of the color wheel schemes because of the true randomness of the color patterns.

This three channel lighting system can also be used outdoors as well as indoors by lighting appropriate floodlamps connected to different channels. These lamps can be made to shine on a given surface such as a front door or in a garden. Many other schemes are

possible and are limited only by the imagination of the user.

III. CANDLE FLICKER EFFECT

Another scheme for Christmass tree lighting can be effected by a minor modification of the single channel circuit to produce a unique candle flicker effect. With this modification, as ordinary series string of lights can be transformed into realistic appearing simulated candles.

FIG. 8 shows a simple molded plastic candle ornament 40 which is adapted to slip over each bulb 42 on a string of lights 44. Each bulb 42 is held in place by the wire 46 in a slotted base 48 forming the bottom of the candle ornament 40.

FIG. 9 shows two ways in which the circuit shown in FIG. 3 can be modified to supply candle flicker operation to the candle ornaments 40. In the first of these two modifications a switch S-3 can be placed in series with a 47K resistor R11 and this can be made to shunt the diode D-2. With the switch closed a sufficiently large AC component is allowed to reach TR-2. This defeats the timing circuits and causes the output to flicker as would a candle flame. With the switch open and no other changes in the circuit the output would be restored to the original fading mode.

The second mode of candle flicker operation is produced by adding a capacitor C-5 through a switch S-2 from the gate of TR-2 to ground. Also R-7, the 82K resistor, is broken into two parts. R-7 becomes 47K and R-10 in series with it is a 50K adjustable resistor R11. No other changes are required.

Unlike the uniform flicker of the candles as in the first mode, the addition of capacitor C5 does not defeat the timing of the oscillator. Instead, the flicker rate of the candles becomes variable and by a minor adjustment of R-10 the flicker rate will slowly modulate from a rapid flicker to a deep flicker for several seconds and then slowly return to a rapid flicker. This effect is much the same as a real candle flickering in a gentle breeze. As before, by opening S-2 and removing the 0.06 0.07 MFD capacitor the circuit immediately is restored to the fading mode of operation instead of candle flicker.

The foregoing detailed description has been given for clearness of understanding only and no unnecessary limitations should be understood therefrom as some modifications will be obvious to those skilled in the art.

I claim:

1. A decorative lighting system comprising:
 - an electrical power source;
 - a plurality of self-modulating half-wave phase control circuits connected to said power source, said control circuits defining multi-channel control means for independently and automatically controlling power through each of the channels between on and off in a repeating gradual and random fashion, each control circuit including a dual frequency oscillator; and
 - a plurality of lamp loads capable of radiating light when triggered on by a flow of power therethrough, each lamp load being connected to a different control circuit, whereby each lamp load is triggered on and off in a repeating gradual and random fashion with respect to each other in response to the power through its respective control circuit.
2. The lighting system of claim 1 wherein each of the lamp loads is a different color.

3. The lighting system of claim 2 wherein the control circuit has three channels and including translucent ornamental enclosure means adapted to receive the three lamp loads therein whereby the ornamental enclosure means exhibits a dynamically changing mono-colored light.

4. The lighting system of claim 3 wherein the color of the lamp loads are red, blue and green.

5. The lighting system of claim 1 wherein each lamp load includes a string of colored lightbulbs.

6. The lighting system of claim 5 wherein the bulbs of each string of lights is the same color and each string of lights has differently colored bulbs than any other string of lights.

7. A decorative lighting system comprising:

- an electrical alternating power source;
- three self-modulating half-wave phase control circuits connected to said power source for independently and automatically controlling power through each of the three channels between on and off in a repeating gradual and random fashion, each control circuit including a dual frequency oscillator;

three strings of colored light bulbs capable of radiating light when triggered on by a flow of power therethrough, each string of lights being connected to a different control circuit, each first, second, third, nth bulb respectively on each string defining a group of corresponding bulbs; and

a translucent ornamental enclosure means adapted to receive a group of three corresponding light bulbs from each string therein forming a single string of a plurality of translucent ornaments, each bulb in each ornament being a different color than the other two bulbs, whereby each string of lights is triggered on and off in a repeating gradual and random fashion with respect to the other strings in response to its respective control circuit so that each ornamental enclosure exhibits a dynamically changing mono-colored light.

8. The lighting system of claim 7 wherein each bulb on each string of lights is the same color and each string of lights has differently colored bulbs than the other two strings of lights whereby every ornamental enclosure will display the same mono-colored light at any given instant in time.

9. The lighting system of claim 8 wherein one string of lights has all red colored bulbs, the second string of lights has all blue colored bulbs and the third string of lights has all green colored bulbs.

10. The lighting system of claim 7 wherein each string of lights has bulbs of identical groups of three different colors arranged in a repeating order so that any three consecutive bulbs are different in color and every third bulb is the same color, and every corresponding bulb being a different color whereby every third ornamental enclosure will display the same mono-colored light at any given instant in time.

11. The lighting system of claim 8 wherein the three colors are red, blue and green.

12. The lighting system of claim 8 wherein the control circuit controls power through each channel between half full power and off.

13. A decorative lighting system comprising:

- an electrical alternating power source;
- a self-modulating half-wave phase control circuit for independently and automatically controlling power

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between on and off in a repeating gradual and random fashion, each control circuit including a dual frequency oscillator;
a lamp load capable of radiating light when triggered on by a flow of power therethrough connected to said circuit whereby the lamp load is triggered on

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and off in a repeating gradual and random fashion in response to said control circuit; and
flicker means associated with said circuit whereby the lamp load is caused to flicker when it is triggered on.

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