United States Patent

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[72] Inventor **Kenneth L. Blakeslee**
330 Glencourtney Drive NW, Atlanta, Ga. 30328

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[54] **PHOTOELECTRICALLY CONTROLLED CONTINUOUSLY VARIABLE COLOR ILLUMINATOR**
7 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **315/154;** 240/3.1; 250/226; 315/155, 315/156, 315/158
[51] **Int. Cl.** **H05b 37/02;** F21p 5/04
[50] **Field of Search** .... 240/3.1, 2, 2, 10, 10.1; 250/219, 226, 231, 233, 208, 209; 315/149, 150, 152—159; 307/311

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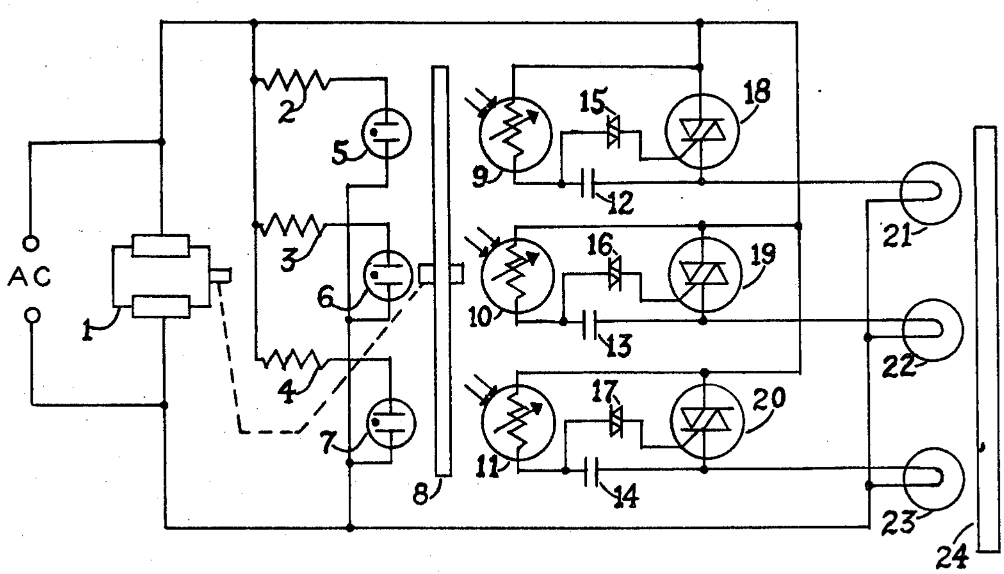
Primary Examiner—John Kominski
Assistant Examiner—E. R. LaRoche

ABSTRACT: A variable color illuminator is a solid state electronic control apparatus designed to operate on alternating current having two or more separate electrical circuits wherein the rate of power dissipation in each circuit is separately controlled and continuously changed. The controlled power dissipation in all circuits is accomplished with a single light attenuation recording which has variations of attenuation from point to point. The recording is continuously moving and is located between light sensitive elements and fixed intensity light sources. The light sensitive elements are an integral part of combined phase shift and pulse networks which activate the power control switches located in each electric circuit. Light variations on the light sensitive elements caused by the light attenuation variations in the moving recording are reproduced as power variations in the control circuits. When colored lights are attached to the power circuits and grouped in clusters, lighting effects are produced for advertising and architecture.



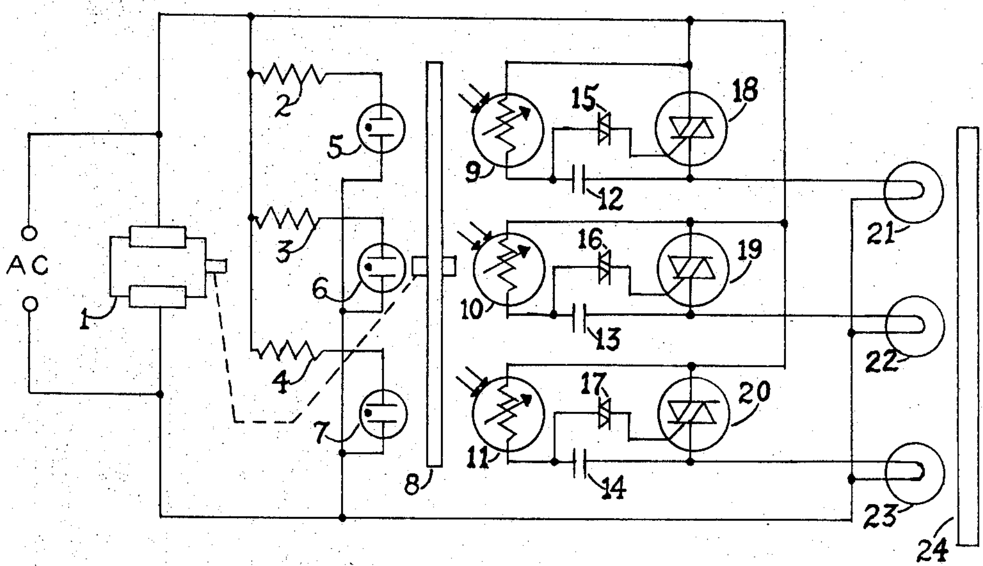


FIG 1

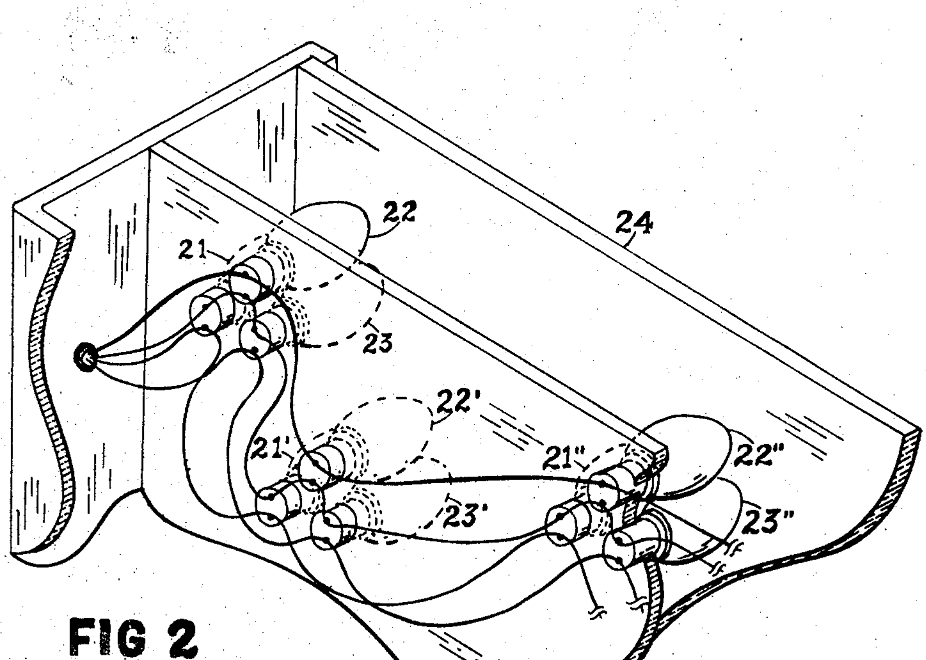


FIG 2

INVENTOR
KENNETH L. BLAKESLEE
Kenneth L. Blakeslee

PHOTOELECTRICALLY CONTROLLED CONTINUOUSLY VARIABLE COLOR ILLUMINATOR

This invention relates to electronic variable color illuminating devices and more particularly to a new and improved device which is capable of providing an illumination having a continuously variable range of hue and intensity. The variations are predetermined and controlled such that the transitions through the entire spectrum can be smooth and continuous, abrupt and spasmodic, or any combination and blend desired and can quickly be altered by changing the recording.

In general, the presently known variable color illuminating devices have required complex mechanical switching arrangements operating according to a simple predetermined program or a mechanical random change, both methods producing coarse and abrupt changes in hue and intensity. This coarseness and simplicity results in devices that quickly lose the observer's attention or produce irritating visual and mental effects.

Accordingly, it is an object of the present invention to provide a new and improved variable color illuminator which overcomes the disadvantages of presently known illuminators.

Another object of the invention is to provide a new and improved variable color illuminator capable of producing an infinite number of different hues and intensities of illumination.

A further object of the invention is to provide an illuminator wherein the color variations are predetermined by a recording, and different color moods can be produced by quickly and easily changing the recording.

An additional object of the invention is to provide a simple, compact, and reliable solid state unit having almost unlimited power handling capabilities at an efficiency greater than 97 percent.

These and other objects of the invention are attained by providing a plurality of electric light sources arranged into two or more separate electrical circuits, each circuit having a plurality of light sources and may or may not have a plurality of colors. A bidirectional triode thyristor in series with each circuit regulates the average current flow in its circuit and accordingly the intensity of the color sources in its circuit by its conducting-to-nonconducting ratio. The conducting-to-nonconducting ratio and color intensity of each circuit is established electronically and controlled by the intensity of light on a plurality of photocells, a single photocell for each bidirectional triode thyristor and each color source circuit. Variations in light intensity on the photocells are produced by a rotating disc having predetermined variations in light transmission through the disc and located between the photocells and their source of light so that as the disc is rotated the light intensity on the photocells is varied according to the light transmission alterations in the disc the said disc being rotated by an electric motor and gear train and being easily removed and replaced with discs having different predetermined variations in light transmission.

Further objects and advantages of the invention will be apparent from a reading of the following description in conjunction with the accompanying drawings in which:

FIG. 1 is a schematic circuit diagram showing the electrical circuit of the present invention; and

FIG. 2 is a prospective rear view of a broken away section illustrating a typical l light source arrangement and electrical wiring connection for a chromagraph having a plurality of lamps arranged into three separate electrical circuits.

In the representative embodiment of the invention shown in the drawings, a chromagraph is composed of an electronic circuit which transforms the predetermined intelligence stored on a revolving disc **8** into controlled electrical currents which in turn determines the intensity of the plurality of color sources **21**, **22**, **23**, and the intensity of color sources connected in parallel as is **21'**, **22'**, and **23'**, and **21''**, and **23''**, in **FIG. 2**.

The method of recording intelligence on disc **8** is to alter the translucency of the disc from point to point as the point is rotated 360° on the disc. Therefore, at any instant the light intensity on photocells **9**, **10**, or **11**, will be determined by the translucency of that part of the disc that is between the photocell and its adjacent light source and the intensity of its adjacent light source. The light sources for photocells **9**, **10**, and **11**, are the glow discharge lamps **5**, **6**, and **7**, respectively. The intensity of the glow discharge lamps **5**, **6**, and **7**, are limited by the individual current limiting resistors **2**, **3**, and **4**, respectively.

Location of the photocells and their adjacent light sources relative to each other and the disc is dependent upon the illumination effect desired. The simplest and most economical arrangement is to place each photocell and its light source on radial lines, 120° apart, the distance from the center being sufficiently less in length than the radius of the disc so that the disc, when placed between the photocells and their light sources can block all light from the photocells. In this arrangement, as the disc rotates, each photocell repeats the variations of the preceeding photocell 120° later. This arrangement reduces the cost but restricts somewhat the variations in hue and intensity. The remaining placement of consequence is to place the photocells on the same radial line, each progressively closer to the center and the most distant being sufficiently close so that the recorded disc when placed between the photocells and their light sources, can block all light from the photocells. While in this arrangement, the cost may be slightly higher since each photocell would have its own recorded track, would not repeat its adjacent photocells and would repeat itself only after a 360 ° revolution of the disc. Greater versatility can be obtained in this arrangement.

Rotation of the disc at a suitable speed by the combined electric drive motor and gear train **1** produce continuous light intensity variations on the photocells according to the continuous changes in translucency of the disc. The light intensity variations on photocells **9**, **10**, and **11**, are electronically reproduced in light sources **21**, **22**, and **23**, respectively and in other color sources that are connected in parallel with them.

The use of an alternating current power source is fundamental to producing color intensity and color intensity changes in the color intensity changes in the color sources similar to the light intensity and light intensity changes on the corresponding photocells. Bidirectional triode thyristors **18**, **19**, and **20**, present a very high resistance to current flow in either direction until gated-on, whereupon its resistance decreases rapidly allowing current to flow through itself and the color source or paralleled sources connected in series with it, until completion of the current flow half cycle and the reversal of current flow direction. At completion of the half cycle and change of current flow direction, the bidirectional triode thyristors recover and again exhibit high resistance characteristics until gated-on. The timing and gating circuit for bidirectional triode thyristor **18**, is photocell **9**, capacitor **12**, and bidirectional diode thyristor **15**, for bidirectional triode thyristor **19**, the timing and gating circuit is photocell **10**, capacitor **13**, and bidirectional diode thyristor **16**, and for bidirectional triode thyristor **20** the timing and gating circuit is photocell **11**, capacitor **14**, and bidirectional diode thyristor **17**.

Gate pulse timing is synchronized to and commences at the instant of completion of each half-cycle and the reversal of current flow direction. Commencing each new half cycle current flowing through the photocell charges the capacitor either positive or negative, the polarity of charge depending upon the direction of current flow. The direction of current flow or voltage polarity is of no consequence since both the diode and triode thryristors are bidirectional current devices. The voltage potential across the capacitor will continue to increase with time until the breakdown potential of the bidirectional diode thyristor is reached, whereupon, it's high resistance characteristic rapidly switches to a low resistance and conducts the capacitor stored energy into the gating terminal of the bidirectional triode thyristor causing it to rapidly switch from a current blocking state to a conducting state. The time delay from start of the new cycle to the instant of the gating pulse is porportional to the resistance of the photocell which is established by the intensity of light on the photocell during that time period.

Once the bidirectional triode thyristor is gated into conduction it remains in that state for the remainder of the half cycle and the timing and gating network is disabled due to the low voltage drop across the bidirectional triode thyristor during its conducting state. The operation of each of the three circuits is identical to within the tolerance of the components used.

A translucent material **24** is used in conjunction with the grouped color sources to transform the individual colors of the group into a color blend by additive mixing the individual intensities of the red, blue and green color sources.

Although the invention has been described herein with reference to a specific embodiment, many modifications therein will readily occur to those skilled in the art. Accordingly, all such variations and modifications are included within the intended scope of the invention as defined by the following claims.

I claim:

1. A continuously variable color illuminator comprising: an alternating voltage source; a plurality of phase controlled electronic switches each having a control electrode; a plurality of colored electric light sources connected in series with each electronic switch and the voltage source; an electronic variable phase shift network connected to each control electrode, each electronic network having a light sensitive resistance element whose resistance determines the phase of the network output; a corresponding number of light sources each located in close proximity to each said light sensitive resistance element; a light modulation means having a point to point variation of light attenuation and located between said light sources and said light sensitive resistance elements; and means for moving the light modulation means.

2. A continuously variable color illuminator according to claim **1** wherein said light sensitive resistance elements are disposed in an arrangement whereby each said light sensitive element has a different resistance value.

3. A continuously variable color illuminator according to claim **1** wherein the brilliance of each said light source is fixed by a series connected current limiting resistor.

4. A continuously variable color illuminator according to claim **1** wherein the resistance of each said light sensitive element is sufficiently reduced to cause maximum brilliance from the colored light sources when the light modulation means causes a minimum attenuation of light between each said fixed light source and its corresponding said light sensitive element.

5. A continuously variable color illuminator according to claim **1** wherein the resistance of each said light sensitive element is sufficiently increased to cause no discernable light emission from the colored light sources when the light modulation means causes a maximum attenuation of light between each said fixed light source and its corresponding said light sensitive element.

6. A continuously variable color illuminator according to claim **1** wherein the light modulation means is continuously moved between said fixed light sources and said light sensitive resistance elements.

7. A continuously variable color illuminator according to claim **1** wherein the resistance of each said light sensitive element is varied continuously between the maximum and minimum value required to cause the brilliance of the colored light sources to be varied continuously between maximum brilliance and no discernable light emission as the light modulation means causes the light intensity from each said fixed light source impinging upon each said light sensitive element to be varied continuously between the required minimum and maximum value.