Oct. 3, 1967 W. C. DAUSER 3,345,509

MULTI-COLOR LAMP

Filed Nov. 23, 1964

2 Sheets-Sheet 1

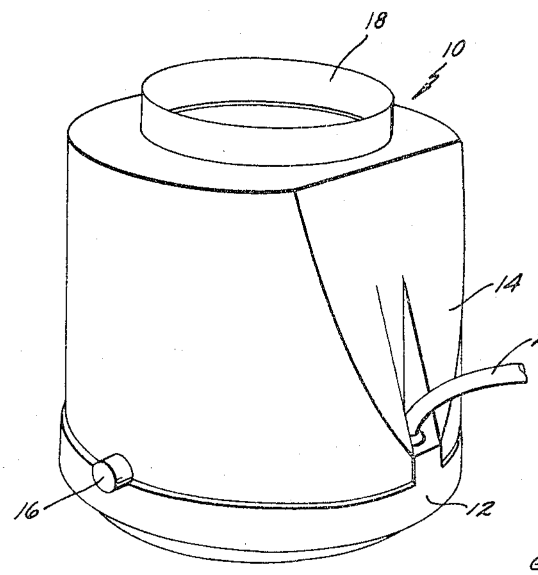

FIG. 1.

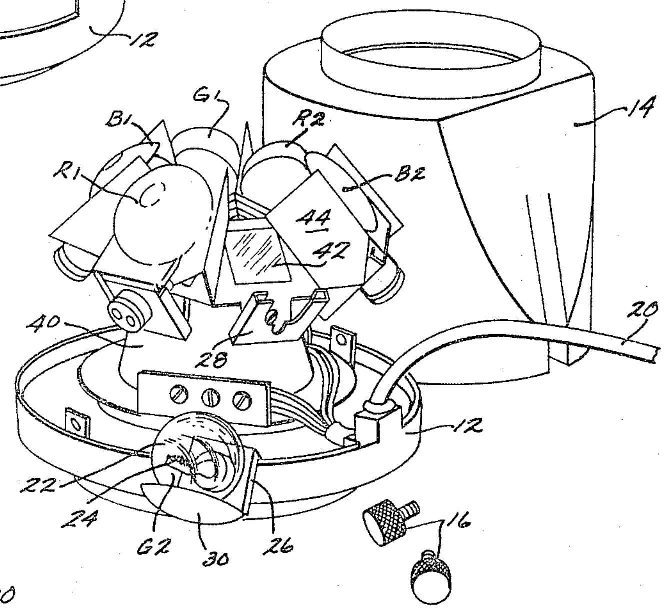

FIG. 2.

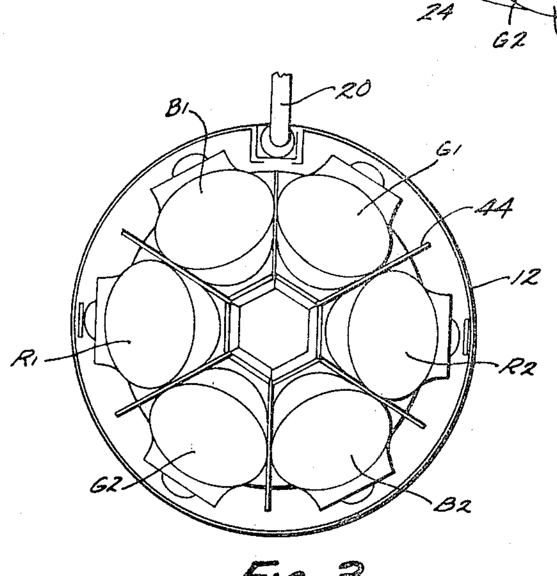

FIG. 3.

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2 Sheets-Sheet 2

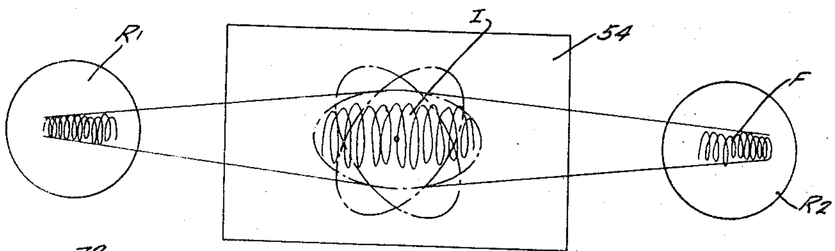

FIG. 5.

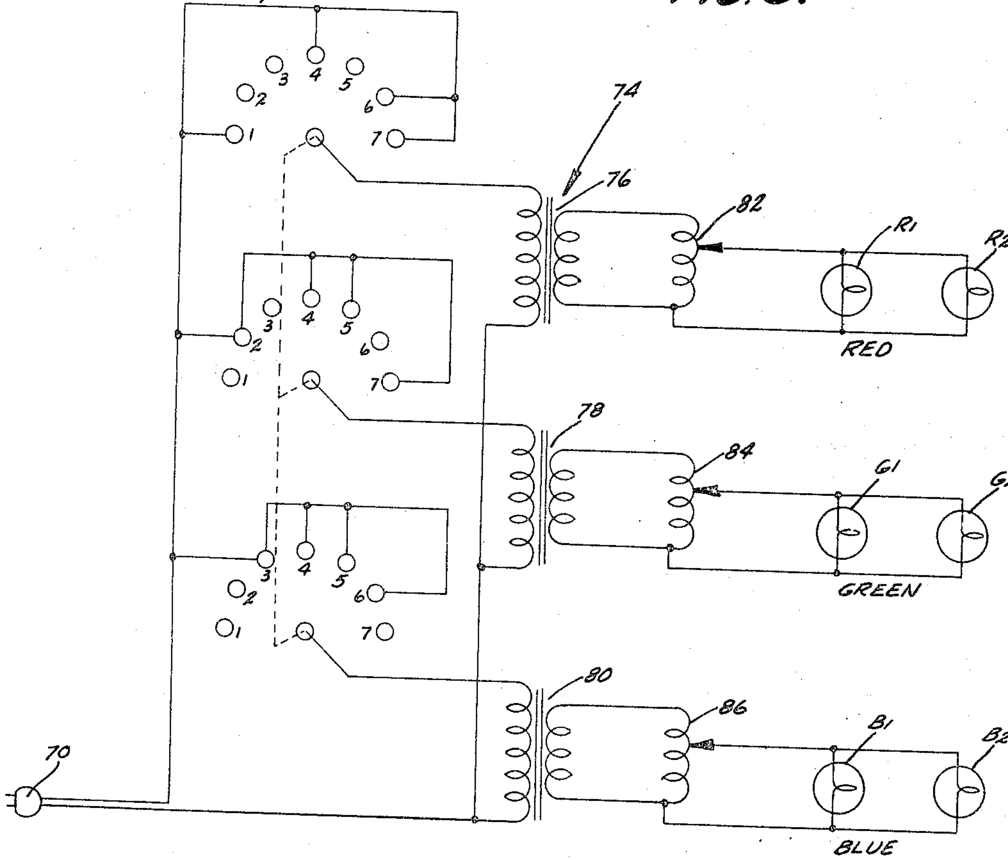

FIG. 6.

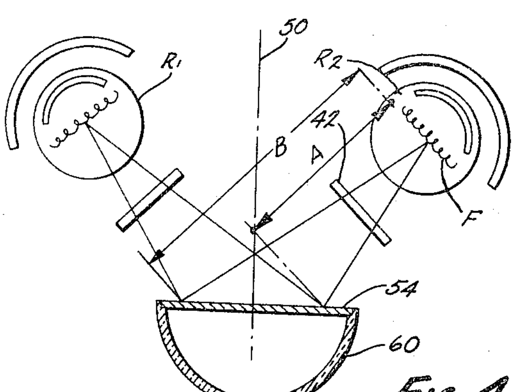

FIG. 4.

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MULTI-COLOR LAMP

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Filed Nov. 23, 1964, Ser. No. 413,231
5 Claims. (Cl. 240—20)

This invention relates to color photography and photographic printing, and related fields, and more particularly to a lamphouse for photographic printing and enlarging.

This is a continuation in part of my co-pending applications entitled, Color Head, filed May 17, 1962, Ser. No. 195,476 and entitled, Color Control Method and Apparatus, filed May 17, 1962, Ser. No. 195,501.

The novel lamphouse is useful for many fields of endeavor involving the production of controlled colored illumination. Since however, the device was developed for and is uniquely suited for color photography, including color analyzing, printing, enlarging, and standardizing, it will be described and explained with respect thereto. The invention has particular adaptability to subtractive multi-layer dye coupling type printing paper, such as the three-layer type sheet paper currently available.

The lamphouse enclosed and claimed in the above identified application Ser. No. 195,476 was designed to simultaneously activate all three layers of such paper, in an accurately controlled manner by employing three different independent light sources of primary colors to form the white or off-white exposure light. This is combined with a special system to direct the light along a central axis.

This prior system works well for equipment such as that taught in the application, but, when used in combination with less sensitive exposure control equipment, sometimes results in color unbalance and uneven illumination, coupled with insufficient illumination over some portions of the print and easel. These characteristics combine to prevent top quality printing.

It is therefore an object of this invention to provide a novel lamphouse that enables top quality printing, enlarging, and color analysis even when used in combination with low sensitivity exposure control equipment.

It is another object of this invention to provide a color head of high quality, controlled light output of desired characteristics, for simultaneous exposure of all three layers of three-layer type sheet paper, while affording completely adequate and uniform illumination for use with even low sensitivity control equipment. Excellent printing can be achieved even with inexpensive paper. A negative can be controllably improved to a better quality print.

Another object of this invention is to provide a light head of simplified construction while affording excellent uniformity of illumination of the controlled color light. This is achieved uniquely by optically converting the separate light sources arranged in a three dimensional pattern, into a two dimensional or planar, combined light source of even illumination characteristics.

Still another object of this invention is to provide a light head of three dimensionally arranged primary color sources which optically form a secondary planar source while achieving the convenience and local control of conventional single exposure equipment, but the purity of saturation of conventional multiple exposure equipment, image definition superior to both, and balanced illumination with intensity sufficient for accurate intensity control of each primary color source.

These and several other objects of this invention will become apparent upon studying the following specification in conjunction with drawings in which:

FIG. 1 is a perspective view of the novel color head;

FIG. 2 is a perspective view of the color head with the housing cover removed;

FIG. 3 is a plan view of the uncovered head in FIG. 2;

FIG. 4 is a schematic ray diagram of two of the light source components and the two related diffuser elements essential to this novel color head;

FIG. 5 is a schematic, plan, ray diagram of the structure in FIG. 4; and

FIG. 6 is a schematic circuit diagram for the color head.

Referring now specifically to the drawings, the complete head **10** includes a mounting base **12** to which a cover **14** is attached by a suitable means such as the threaded fasteners **16**. The top of the housing is open at **18** for attachment of a cooling blower (not shown). Electrical input to the housing is made through cord **20**.

Housing shell **14** can be removed from base **12** as shown in FIGURE 2, by removal of screws **16**. This exposes the interior of the housing, and more specifically, the light source components with their corresponding selective filters.

These light sources **G1**, **G2**, **B1**, **B2**, and **R1** and **R2** are arranged in a particular geometrical cluster. More specifically, the two lights **G1** and **G2** to supply the green primary color component are directly opposite each other, in the preferred form of the structure. Likewise, the two lights **B1** and **B2** to supply the blue color are opposite each other, as are lights **R1** and **R2** which supply the red light. Each of these lights is basically a white light source, composed of all of the spectral components. Each light includes a globe **22** enclosing a filament **24** which is electrically connected through the slide connector block **26** to power supply means in the electrical connector socket **28** of generally rectangular configuration. A reflector **30** may be either external, or coated on the globe, or internal of the globe, to orient the light toward the center of the structure, and more specifically through the dichroic filters provided.

The dichroic filters are each mounted in the upright extension **40** of base **12** as shown by filter **42** for light **G2**, which is shown in FIG. 2 removed from its slide socket **28**. The lights and dichroic filters are separated by baffles **44**. These dichroic filters are preferably the type known as spectral selectors. Each is constructed to pass only one particular wave length range of light while reflecting the remaining wave lengths. More specifically, the spectral selectors for bulbs **R1** and **R2** to allow red light to pass is composed of a transparent base such as quartz or glass upon which is coated a multiple of coatings of rare earth metals. The total thickness is normally no greater than about 40 microinches. These multiple coatings are placed directly one upon another, without any intermediate material being placed therebetween. The selectors are placed perpendicular to the central axis of the light beams. They may, for example, be of the type marketed by Bausch & Lomb and identified as Red Selector 90–2–600 as coupled with 90–2–540, Green Selector 90–4–540 as coupled with 90–2–480, and Blue Selector 90–1–480 as coupled with 90–1–540. In each case the first number identifies the angle of incidence of the light, i.e., the 90-degree angle as illustrated in the drawings. The second number is a Bausch & Lomb design designation which indicates whether the selector is a short, long, or band wave transmitter. The third defines a functional wave length. If the filter has a single cut-off which must be defined, this third number is the wave length in millimicrons at the 50% transmittance point on this cut-off. This, for example, is true for the blue multifilm selector which passes wave lengths below the visible range of about 400 millimicrons (ultra-violet) as well as blue. This also is true for the red selector which passes wave lengths above the visible range of about 700 millimicrons (infrared) as well as red. The green filter, on the other hand, falls in the middle of the visible range from 400–700 millimicrons wave length and possesses two cut-offs. Its third number, therefore, refers to the wave length at the center of the band transmitted. Explained in another way, for example in the identification 90–1–480, **1** indicates short wave transmission which means that all waves below 480 millimicrons are transmitted. In 90–2–600, **2** means long wave transmission, that is, all waves above 600 millimicrons are transmitted. In 90–4–540, **4** means a band with transmission, namely transmission of a band of frequencies between 530 and 550 millimicrons. The dichroic filters are therefore not subtractive filters and achieve controlled wave length transmission of selected colors.

The three primary colors red, green and blue, when in equal proportions, constitute means for forming white light of pure characteristics. Unique to this disclosed structure is the placement of the green, red and blue respective pairs of lights opposite each other, i.e., in a pattern form of equal spacing around the periphery of the structure, and equally spaced from the center line **50** (FIG. 4).

As a consequence, using the red lights R1 and R2 as examples, these transmit light from their respective filaments through their spectral selectors and oriented toward a planar opal diffuser or frosted glass plate **54**. Referring to bulb R2, the light transmitted from its filament strikes the opal diffuser **54** across its center line in a pattern area so that the shorter rays are of length A and the longer rays are of length B as shown. However, the illumination in the area is equal and balanced, since the oppositely positioned bulb has just the opposite effect, so that the cumulative light achieves uniform illumination. Actually, it has been determined by experimentation that the planar opal diffuser **54** serves as a screen for the formation of an image I of the filament F in a generally ovular area like that illustrated in FIG. 5 in two dimensions. This area is evenly illuminated over its extent. The filament image is therefore planar, and is on the axis or center line **50**. With all six bulbs, or even more in equal numbers, the three ovular areas, of which two are shown in phantom in FIG. 5, together effect a simulated light source of planar or two dimensional characteristics on the center line of the system. In order to be useful, the planar diffuser, acting as a screen, must be combined with an underlying hemispherical diffuser **60** adjacent thereto, to diffuse the light from the simulated filament sources on diffuser **54**. It will be realized that this combination acts in effect like an actual light with a filament image on diffuser **54**, and with opal hemisphere **60** acting as a light globe. However, the filament image is planar and superior to a three dimensional filament for photographic purposes. Hence, the result is superior lighting with balanced illumination, increased intensity of illumination, and uniformity of diffusion over the area beneath the opal hemisphere where the easel would be mounted when the head is used for photographic purposes.

To achieve equal illumination of each pair of lights, a circuit as illustrated in FIG. 6 is employed. This includes a suitable electrical connector **70** preferably in a form of an electrical timer when the structure is used for photographic purposes, a selector switch **72**, transformer means **74**, and the plurality of independent circuits for red, green and blue light. More specifically, the multiple throw switch **72** includes three selectors operated in gang fashion, with seven selected terminals for each of the three selectors, to enable different colors to be formed by varying the red, green, and blue primary input intensities. Thus, with the switch in position **1**, for example, contact is made solely with the circuit through transformer coils **76** for the red bulbs R1 and R2. Contact **2** causes connection only through coils **78** for green bulbs G1 and G2. Likewise, contact **3** causes only blue light through transformer coils **80** and blue lights B1 and B2. Contact **4** combines red and green and blue, No. **5** combines blue and green, No. **6** combines blue and red, and No. **7** combines green and red. Potentiometers **82**, **84** and **86** allow individual intensity control for the red, green and blue primary sources, for optimum color balancing.

In use of the novel color head therefore, the individual colors or any combination thereof, can be selected at will. Yet illumination will always be balanced, uniform and of optimum illuminating characteristics, due to the balanced action of the oppositely positioned lights, and the combination thereof with planar and hemispherical diffusers to achieve simulated planar filament images of symmetrical patterns, with diffusion through the hemispherical opal diffuser.

Conceivably certain additional advantages of this novel structure will occur to those in the art upon studying the foregoing specifications and drawings. Also, since changes in detail could conceivably be made without departing from the concept presented, the invention is to be limited only to the scope of the appended claims and the reasonably equivalent structures to those defined therein.

I claim:

1. A lamphouse with controlled, balanced, even illumination comprising: a plurality of variable intensity, primary color, light sources for three primary colors, arranged radially around a central axis, and positioned to focus at a position located on said axis; at least two sources for each primary light arranged at equal intervals around said axis, opposite each other; a planar diffusor element positioned on said axis at said position to receive the focused primary color light components and combine them into a secondary light source, and to diffuse the combined light while transmitting it; and a hemispherical diffusor on said axis spaced from said diffusor element to receive light from said element and transmit it evenly to an area to be illuminated.

2. A lamphouse with controlled, balanced, even illumination comprising: a plurality of variable intensity, primary color, light sources for three primary colors, arranged radially around a central axis at equal spacings therefrom, and positioned to focus at a position located on said axis; configurated reflector means behind each of said sources causing stray light therefrom to be focused at said position on said axis, at least two sources for each primary light, arranged at equal intervals around said axis, opposite each other; a planar, opal diffusor element positioned on said axis at said position to receive the focused primary color light components and combine them into a planar secondary light source; and a hemispherical diffusor on said axis adjacent said diffusor element opposite said light sources, to receive light from said element and transmit it evenly to an area to be illuminated.

3. A lamphouse with controlled, balanced, even illumination comprising: a plurality of variable intensity, primary color, light sources for three primary colors, arranged radially around a central axis, and positioned to focus at a position located on said axis; at least two sources for each primary light, arranged opposite each other, and common variable power supply means to both of said two sources for each color, for completely balanced lighting even when the intensity of the sources for each primary color is varied; a diffusor element positioned on said axis at said position to receive the focused primary color light components and combine them into a secondary light source, and to diffuse the combined light while transmitting it; and a hemispherical diffusor on said axis spaced from said diffusor element to receive light from said element and transmit it evenly to an area to be illuminated.

4. A lamphouse comprising: a plurality of light sources arranged radially around a central axis, and positioned to illuminate an area located on said axis; spectral selector means for three primary colors between respective sources and said area; each of said primary colors formed from at least two sources, the sources of each of a given primary color being spaced at equal intervals around said axis; the number of sources of each of said primary colors being the same; a diffusor element located on said axis at said area to receive and combine the primary light illumination into a planar secondary source; and a hemispherical opal diffusor on said axis beneath said diffusor element, receiving the combined light therefrom and transmitting it evenly to an area to be illuminated.

5. A photographic printing lamphouse comprising: a plurality of an even number of light sources arranged radially around a central axis, in a plane; said sources including configurated reflector means focusing the light to a common position along said axis displaced from said plane; the beams of said sources all converging from said sources to said position; a planar opal diffusor plate located on and normal to said axis at said position; said light beams each being focused on said plate in the shape of an oval; spectral selector means between each of said sources for three primary colors to produce an even number of sources of each primary color; said sources for each primary color being positioned oppositely across

said axis to balance the illumination of the oval pattern for that color; the combined ovals forming a controlled planar, white light source on said axis; and a hemispherical opal diffusor on said axis, spaced from said plate, receiving the combined light and uniformly illuminating an area beyond it.

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