Aug. 17, 1954 R. G. WILLIAMS 2,686,866

COLOR MIXING LIGHTING APPARATUS

Filed Dec. 20, 1949

2 Sheets-Sheet 1

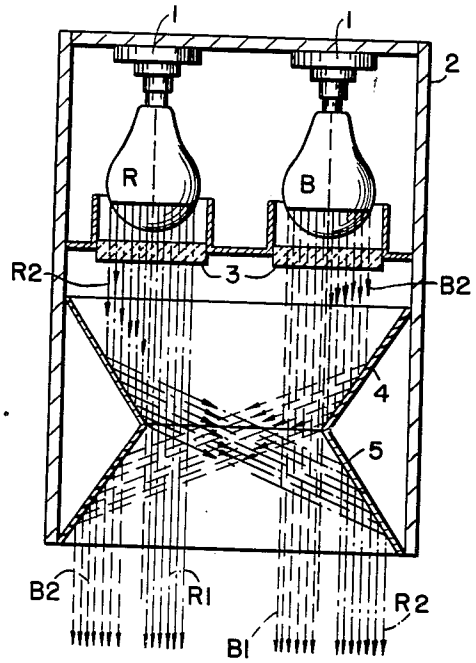
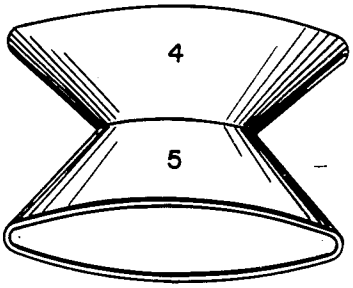


Fig-1-

Fig-3-



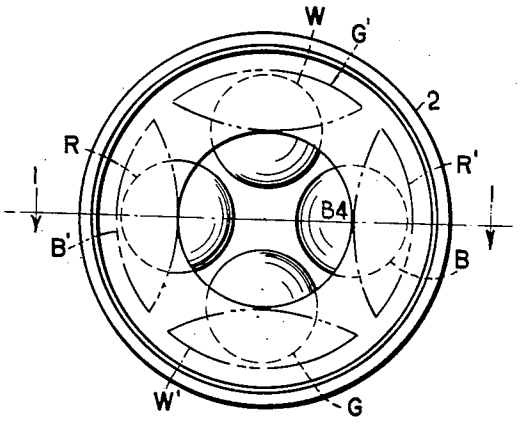


Fig-2-

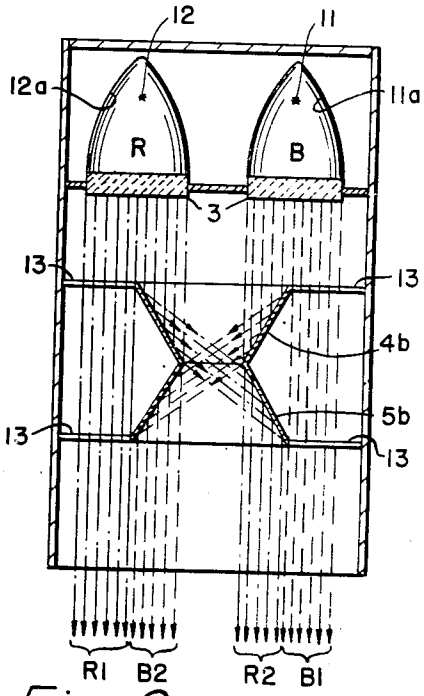


Fig-6-

INVENTOR.
ROLLO GILLESPIE WILLIAMS
BY
Dicke and Padlon
ATTORNEYS

Aug. 17, 1954 R. G. WILLIAMS 2,686,866

COLOR MIXING LIGHTING APPARATUS

Filed Dec. 20, 1949

2 Sheets-Sheet 2

Fig-4-

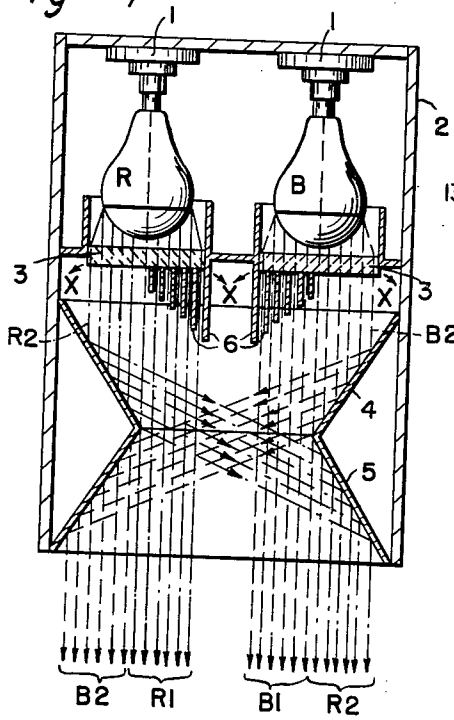


Fig-8-

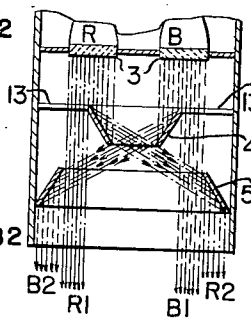


Fig-9-

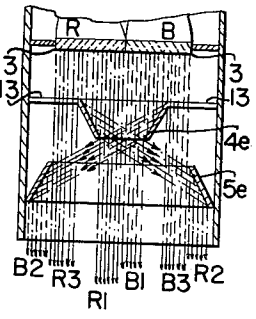


Fig-7-

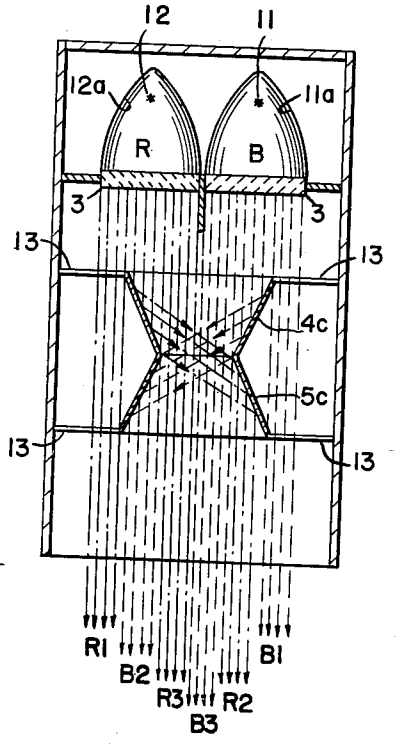
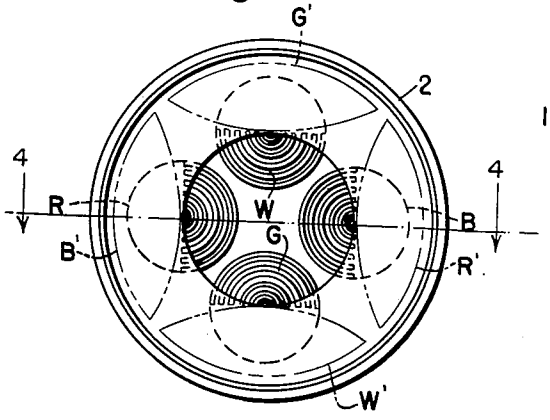


Fig-5



INVENTOR.
ROLLO GILLESPIE WILLIAMS
BY
Dicke and Padlon
ATTORNEYS

Patented Aug. 17, 1954

2,686,866

UNITED STATES PATENT OFFICE

2,686,866

COLOR MIXING LIGHTING APPARATUS

Rollo Gillespie Williams, Great Neck, N. Y., assignor, by mesne assignments, to Duro-Test Corporation, North Bergen, N. J., a corporation of New York

Application December 20, 1949, Serial No. 133,992

10 Claims. (Cl. 240—3.1)

1

This invention relates to color mixing lighting apparatus and has particular but not exclusive reference to spotlights.

An object of the invention is to enable a number of light beams of different colors or a number of light sources each giving a light of different color to provide illumination which can be blended into one final beam of light of resultant color.

It is sometimes desired to mingle the light of a plurality of colors such for example as the four colors, white, red, green, and blue, in such a manner that by blending the lights in different proportions different color hues are obtained. If four spotlights corresponding to these four colors are mounted close together, it will be found that undesirable color shadows are created and the four beams do not generally intermingle sufficiently to avoid what is known as color fringing.

It is therefore desired that these beams should be so intermingled that the colors in question can be sufficiently combined to avoid these phenomena, and an object of the present invention is to provide a simple but effective apparatus whereby this result may be achieved. It is to be understood, however, that this invention applies to the combination of any required number of colored light sources, and that the number "four" is quoted merely as an example. Also the source can be arranged to give any desired color of light and means may be employed for varying the color and/or intensity of the useful emitted blended light. For example, in the case of a plurality of light sources, individual dimmers may be employed to vary the useful emitted light.

Other specific objects of the invention are to provide means for mixing colored lights which are simple in construction and design, are comparatively inexpensive to make, are compact and comparatively small in size, are easily and readily maintenanced and are possessed of a high degree of lighting efficiency.

Another object is to provide a light transmission system consisting of at least two light reflecting systems so arranged and designed that a predetermined proportion of emitted light is transmitted independently of said system and the remainder is reflected from the first to the second system and from such latter system is transmitted in substantial parallel spaced relation to the independently transmitted light.

A more specific object of the invention is to provide a light transmitter consisting of at least two truncated conical, pyramidal or the like re-

2

flecting surfaces disposed in an opposed sense about a substantially common axis with their bases remote from each other; the two truncated conical reflecting surfaces may be the same as or different from one another as desired; they may be symmetrical or asymmetrical and, as a cone is mathematically that special form of pyramid having an infinite number of sides, the expression truncated pyramidal reflecting surface as used herein where the context so permits, means and includes a multi-sided member having the general outline of a truncated cone. In particular, one of the reflecting surfaces may be constituted by a single surface (conical) and the other is constituted by a plurality of surfaces (pyramidal).

More specifically the invention has for an object the provision of a plurality of light sources, means for transmitting different colored light from or via each or selected thereof, at least two reflecting systems, the one of said systems reflecting a proportion of the emitted light from at least one of said sources on to the other system and said latter system reflecting said reflected light in substantial parallelism and in spaced relation to the remaining proportion of the emitted light from said source.

In the alternative a single light source may be employed and means are provided whereby two or more substantially parallel light beams of different color or hue are obtained from said single source and a proportion of one or more of said beams is/are applied to said reflecting systems in manner set out above.

It is another object to provide special means for insuring that the emitted light which is transmitted independently of said reflector system is confined to mainly parallel rays of light, and to that end it is another object to provide louvres or shields so located relative to the light source or each light source that such independent light is transmitted mainly as parallel rays.

In carrying the invention into effect the two reflecting systems may be spaced from one another or otherwise as desired, but in the latter event they are preferably connected by an opaque connection. The reflecting surface of each or either system may be ribbed, flutted, smooth, indented or irregular. The reflecting systems or either thereof may include a transparent part or parts for the non-reflected light.

The invention contemplates both the provision of a complete lighting system for transmitting light and a transmitter for use with a lighting system.

Other objects will become apparent from the following description taken in connection with the attached drawings showing several illustrative embodiments of the invention and wherein:

Fig. 1 is a horizontal cross-sectional view along the axis 1—1 of Fig. 2 illustrating by way of example one form of the spot light in which the invention is embodied, the view in Fig. 1 omitting one of the lamps shown in Fig. 2 to avoid confusion in the drawing;

Fig. 2 is a vertical end view of the spot-light shown in Fig. 1;

Fig. 3 is a perspective view of one type of reflector in accordance with this invention;

Fig. 4 is a horizontal cross-sectional view along the axis 4—4 of Fig. 5 showing a modified form of the invention in Fig. 1 showing the use of louvres positioned in front of the light sources;

Fig. 5 is a vertical end view of the form of Fig. 4; and

Figs. 6, 7, 8, and 9 are views similar to Fig. 1 showing further modified forms of the invention.

In the embodiment illustrated there are four sources of light, R, W, B, and G, each of which may be an electric lamp bulb. It will be appreciated that any suitable source of light may be employed and reflector spot lamps have been found to be suitable.

Each lamp is supported by a lamp holder 1 and the lamps are arranged concentrically equally spaced from one another. The lamp holders 1 may be located interiorly of a suitable casing indicated generally at 2 which may be provided with any convenient means for mounting or attaching it to any desired support. Disposed at a convenient position below the bulbs R, G, and B, is a color filter 3. In the particular embodiment under discussion it will be assumed that lamp R will emit (through its associated filter) a red beam, lamp G a green beam, lamp B a blue beam and lamp W a white beam but it will be obvious that any desired color or colors may be obtained and the number of different colored beams emitted can be varied as desired. Furthermore, instead of using filters, the lamps themselves may emit light of the desired color.

In a still further alternative, parallel spaced beams of differently colored light are obtained from a single source by any convenient means such as the use of prisms and filters.

Reverting to the embodiment of the invention illustrated in Figs. 1 to 3, it will be seen that at a convenient distance below the filters 3 are located two truncated hollow cones 4 and 5 which are similar and symmetrical and have a common axis; they are arranged in an opposite sense with their bases remote from one another and with their other ends in contact with each other. The interior surfaces of members 4 and 5 are reflecting surfaces. The cones may, for example, be made of anodised aluminum but they may be made of any other suitable material provided they have a good reflecting surface.

It will be readily seen from Fig. 1 that each lamp is so disposed in relation to the cones that a proportion of the emitted light passes through the aperture at the junction of the cones without impinging on any of the interior surfaces of the cones and that the remainder of the light impinges upon the interior surface of the upper cone 4, from there is reflected more or less diametrically to the interior surface of the lower cone 5 and from such latter surface is reflected more or less parallel to and in spaced relation with the light which passes through the cones without impinging upon any surface thereof.

For the purpose of convenience the light rays from lamps B and R only are shown on the drawing but it will be appreciated that the same conditions will apply to the rays emitted from all the lamps. The rays from lamps B and R which pass the cones without impinging upon any of the surfaces thereof are indicated at B_1 and R_1 and the remaining rays are indicated at B_2 and R_2.

An approximation of the reflecting surface area from which the rays B_2 are reflected from the lower cone 5 is indicated at B' in Fig. 2 and it will be seen that that area is considerably greater than the area B_4 from which the light rays B_1 are emitted. This, as will readily be appreciated results in very efficient mixing of the colors. It will be appreciated that cones 4 and 5 are securely fixed within the casing 2 by any suitable and convenient means.

Referring now more particularly to the modified form shown in Figs. 4 and 5, it has been discovered that there may be a tendency for light to "spill" from each filter; that is to say there is a tendency for light rays to be emitted in the direction of the arrows X. In so far as concerns the rays which impinge upon the cones, the spilled light impinges upon the casing 2 and can be ignored but in so far as concerns the independent light, the rays X moving to the left from bulb B (in Figure 4) will intermingle with the rays X moving to the right from bulb R and in order to avoid this spilling (which, of course, occurs at all points of emission of the independent light) and the consequential diffusion arcuate louvres or shields 6 are provided as shown. There are conveniently a series of concentric louvres the lengths of which are stepped as shown, those furthest from the center being of greater length and extending to a position beyond the upper edge of cone 4. The louvres may be of any suitable material and are preferably opaque to light and extend parallel to one another and to the axes of the cones. It thus follows that any spilling of the independent light is positively prevented.

The lamp bulbs may be of any suitable type as, for example, of the reflector type and for the purpose of compactness may be of low voltage (e. g. 6 or 12 volts). It may be said that reflector type bulbs comprise a glass or other suitable bulb which is externally prepared as a reflector and silvered or similarly treated on the interior surface.

It will be noted that in the forms shown in Figs. 1 to 5, inclusive, those portions of the several light beams which bypass the reflectors pass through the aperture in the reflectors. Fig. 6 shows a modified form in which that portion of the several beams of light which bypass the reflectors pass on the outside of the reflectors 4*b* and 5*b*. This provides a similar scrambling or mixing of the light beams of different colors. In this form the reflectors are supported from the casing by means of arms 13. It will be noted that the light sources 11 and 12 are enclosed in reflectors 11*a* and 12*a*, respectively, these reflectors being of parabolic or other similar cross-section to parallelize the rays.

Fig. 7 shows a form similar to that of Fig. 6 except that the colored glass plates 3 are made larger and arranged as close together as possible so that the beams of each color are split into three portions, one of which passes directly

through the apertures in the reflectors 4c and 5c, a second portion is reflected from reflector 4c to and from the reflector 5c and the third portion of each beam passes outside of the reflectors. It will be noted that with this form of the invention each beam is split into three parts so that if four light sources are used, twelve beams of various colors are emitted, and that these beams are thoroughly mixed or scrambled.

Fig. 8 shows another form of the invention using a fairly small reflector 4d and a larger reflector 5d, they being so arranged that one portion of each beam passes between the reflectors whereas the balance of each beam is reflected from reflector 4d onto and from reflector 5d.

Fig. 9 shows a form of construction similar to that of Fig. 8, the difference being that the members 3 are made larger and located as close together as possible so that each beam is split into three parts, one part passing through the center of reflectors 4e and 5e, another portion is reflected from reflector 4e onto and from reflector 5e and the third portion is emitted directly exteriorly of reflector 4e and interiorly of reflector 5e. This again splits each beam into three portions in scrambled or interspersed relation to portions of the beams of other colors.

It will be appreciated that a color mixer in accordance with this invention can be produced comparatively inexpensively, is comparatively robust and has the further advantage that maintenance costs are very small.

While in some of the forms illustrated the beams of light of different colors are shown as coming from individual light sources, it will be understood that a plurality of such beams or all such beams may emanate from a single light source. One form of construction for accomplishing this is shown, for example, in Fig. 7 of my Patent No. 2,673,923, issued March 30, 1954, to which reference is made.

It will be noted that the constructions shown and described will serve admirably to accomplish the objects stated above. It is to be understood, however, that the constructions disclosed above are intended merely as illustrative of the invention and not as limiting as various modifications therein may be made without departing from the invention as defined by the claims which follow.

I claim:

1. In color mixing lighting apparatus, means for emitting discrete light beams of a plurality of different colors, a centrally perforated reflector mounted adjacent said emitting means having a larger end nearest said emitting means and so located that a portion of each beam is emitted through the central opening in said reflector, and a second centrally perforated reflector mounted coaxially with said first reflector and further from said light beam emitting means, and having its smaller end adjacent to the smaller end of the first mentioned reflector, the said reflectors being so formed that the balance of each beam impinges on said first mentioned reflector, is reflected therefrom onto the second reflector and is reflected from said second reflector in a direction substantially parallel to without intermingling therewith the directly emitted portion of the respective beam.

2. In color mixing lighting apparatus, means for emitting a plurality of integral light beams each of different color, a reflector of truncated pyramidal form mounted adjacent said light beams with its larger end nearest said emitting means and so located that a portion of each beam is emitted through the opening in said reflector, and a second reflector of truncated pyramidal form mounted coaxially with said first reflector and further from said light beam emitting means, and with its smaller end adjacent to the smaller end of the first mentioned reflector, the said reflectors being so formed that the balance of each beam impinges on said first mentioned reflector, is reflected therefrom onto the second reflector and is reflected from said second reflector in a direction substantially parallel to without intermingling therewith the directly emitted portion of the several beams.

3. In color mixing lighting apparatus, means for emitting spaced parallel light beams of a plurality of visibly different colors, a reflector of truncated-conical form mounted adjacent said light beam emitting means with its larger end nearest said emitting means and with its axis substantially parallel to and equally spaced from said light beams and so located that a portion of each beam is emitted through the opening in said reflector, and a second reflector of truncated-conical form mounted coaxially with said first reflector and further from said light beam emitting means, and with its smaller end adjacent to the smaller end of the first mentioned reflector, the said reflectors being so formed that the balance of each beam impinges on said first mentioned reflector, is reflected therefrom onto the second reflector and is reflected from said second reflector in a direction substantially parallel to the directly emitted portion of the several beams.

4. The combination according to claim 1 in which means are provided to ensure that that portion of each beam which is emitted through the opening in the first reflector is emitted only as substantially parallel rays.

5. The combination according to claim 1 in which means are provided to ensure that that portion of each beam which is emitted through the opening in the first reflector is emitted only as substantially parallel rays, said means comprising concentrically arranged light guides.

6. In color mixing lighting apparatus, means for simultaneously emitting a plurality of parallel light beams each of a different color, a reflector of truncated-pyramidal form mounted adjacent said light beam emitting means so located that a portion of each of said beams impinges upon and a portion bypasses said reflector, and a second reflector of truncated-pyramidal form mounted further from said light beam emitting means, the said reflectors being so formed and arranged that the portions of said beam which impinge on said first mentioned reflector are reflected therefrom onto the second reflector and are reflected from said second reflector in a direction substantially parallel to the bypassed portions of the said beams.

7. In color mixing lighting apparatus, means for emitting spaced light beams of a plurality of visibly different colors, a reflector of truncated-pyramidal form mounted adjacent said light beam emitting means with its larger end nearest said emitting means and so located that a portion of each beam bypasses said reflector, and a second reflector of truncated-pyramidal form mounted coaxially with said first reflector and further from said light beam emitting means, and with its smaller end toward the smaller end of the first mentioned reflector, the said reflectors being so formed and mounted that a portion of each beam may pass through apertures at the center of said reflectors, that another portion

may pass exteriorly of at least one of said reflectors and that the balance of each beam impinges on said first mentioned reflector, is reflected therefrom onto the second reflector and is reflected from said second reflector in a direction substantially parallel to the directly emitted portions of the said beams.

8. In color mixing lighting apparatus, means for emitting spaced light beams of a plurality of visibly different colors, a reflector of truncated-pyramidal form mounted adjacent said light beam emitting means with its larger end nearest said emitting means and so located that a portion of each beam bypasses said reflector, and a second reflector of truncated-pyramidal form mounted coaxially with said first reflector and further from said light beam emitting means, and with its smaller end toward the smaller end of the first mentioned reflector, the said reflectors being so formed and mounted that a portion of each beam may pass exteriorly of both of said reflectors and that the balance of each beam impinges on said first mentioned reflector, is reflected therefrom onto the second reflector and is reflected from said second reflector in a direction substantially parallel to the directly emitted portions of the said beams.

9. In color mixing lighting apparatus, means for emitting spaced light beams of a plurality of visibly different colors, a reflector of truncated-pyramidal form mounted adjacent said light beam emitting means with its larger end nearest said emitting means and so located that a portion of each beam bypasses said reflector, and a second reflector of truncated-pyramidal form mounted coaxially with said first reflector and further from said light beam emitting means, and with its smaller end toward the smaller end of the first mentioned reflector, the said reflectors being so formed and mounted that a portion of each beam may pass exteriorly of one of said reflectors and interiorly of the other reflector and that the balance of each beam impinges on said first mentioned reflector, is reflected therefrom onto the second reflector and is reflected from said second reflector in a direction substantially parallel to the directly emitted portions of the said beams.

10. In color mixing lighting apparatus, means for emitting spaced light beams of a plurality of visibly different colors, a reflector of truncated-pyramidal form mounted adjacent said light beam emitting means with its larger end nearest said emitting means and so located that a portion of each beam bypasses said reflector, and a second reflector of truncated-pyramidal form mounted coaxially with said first reflector and further from said light beam emitting means, and with its smaller end toward the smaller end of the first mentioned reflector, the said reflectors being so formed and mounted that a portion of each beam may pass through apertures at the center of said reflectors, that another portion may pass exteriorly of one of said reflectors and interiorly of the other reflector and that the balance of each beam impinges on said first mentioned reflector, is reflected therefrom onto the second reflector and is reflected from said second reflector in a direction substantially parallel to the directly emitted portion of the said beams.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
167,188	Murch	Aug. 31, 1875
211,648	Bouchard	Jan. 28, 1879
1,085,795	Boyle	Feb. 3, 1914
1,223,459	Whitney	Apr. 24, 1917
1,949,892	Wright	Mar. 6, 1934
2,430,472	Levy	Nov. 11, 1947