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J. PORTEOUS
LIGHTING FIXTURES

2,831,966

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2 Sheets-Sheet 1

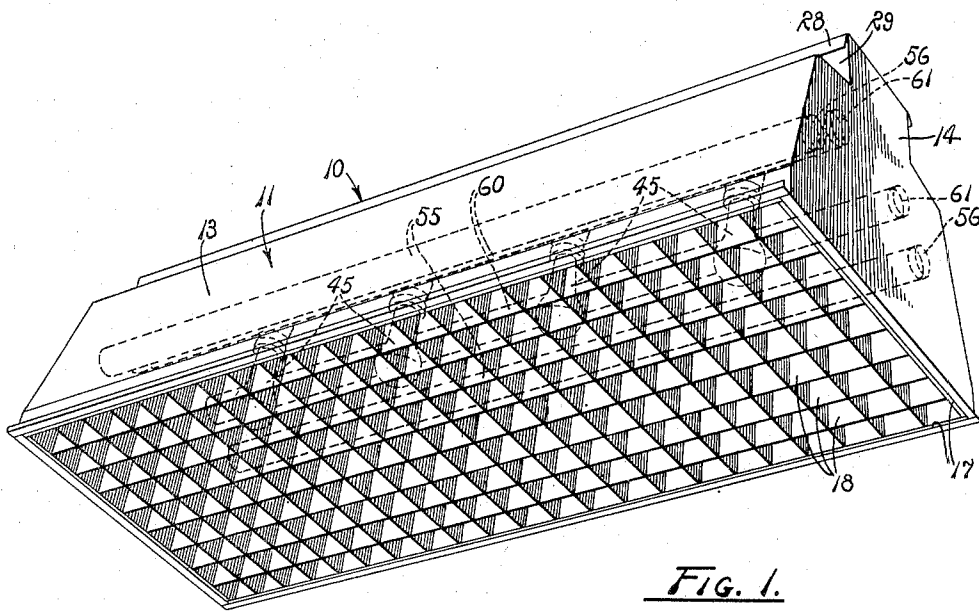


FIG. 1.

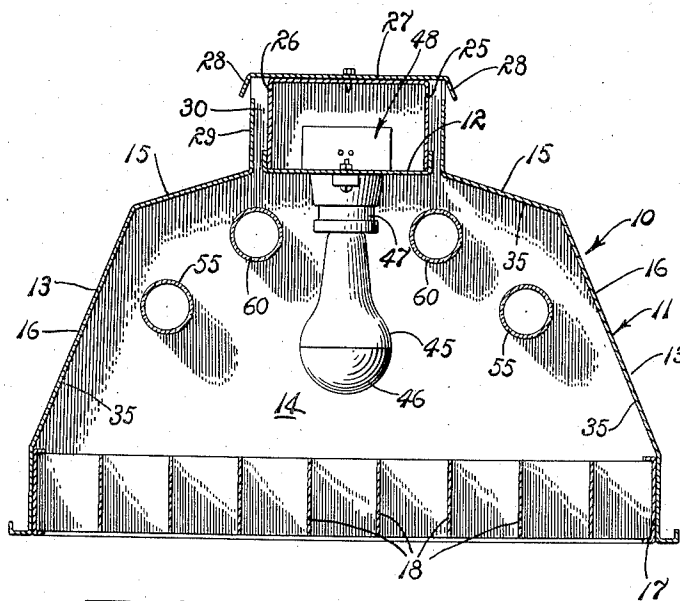


FIG. 2.

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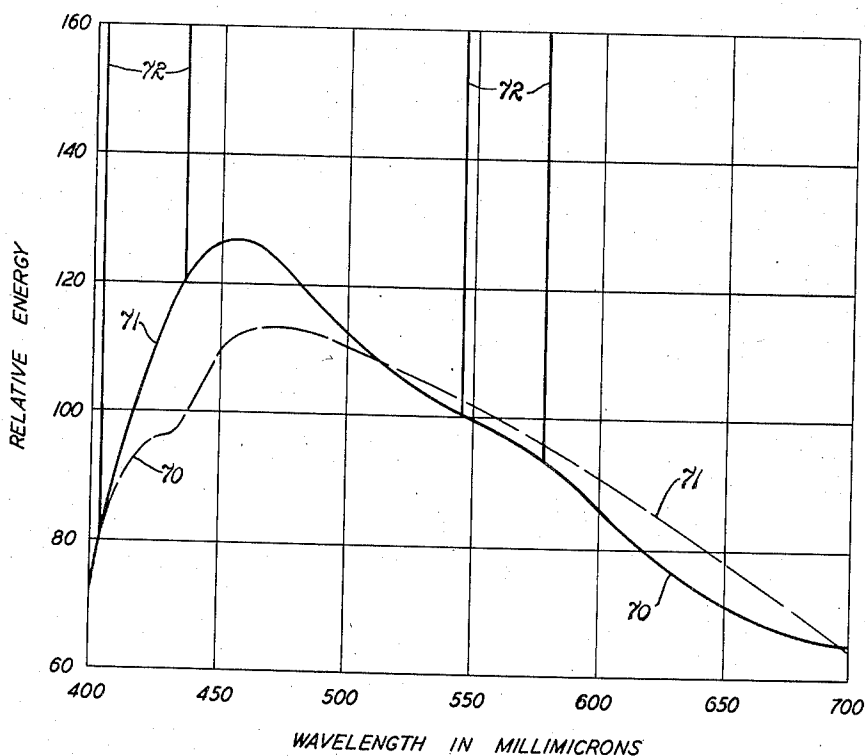


FIG. 3.

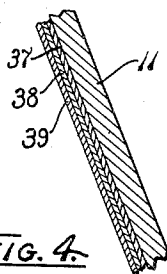


FIG. 4.

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LIGHTING FIXTURES

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2 Claims. (Cl. 240—1.1)

The present invention relates to lighting fixtures and more particularly to such a fixture suited to the improved simulation of daylight and other light of predetermined characteristics involving a plurality of wave lengths. The invention is regarded as a companion improvement to the invention shown and described in the copending application of David S. Amour, Serial No. 319,867, filed November 12, 1952, which issued as Patent Number 2,725,461 on November 29, 1955, and which is assigned to the same assignee as the subject application.

In the lighting industry, the artificial simulation of illumination closely approaching light from the sun, or natural daylight, has long been a goal. The advantages of having light substantially equivalent to natural daylight available for indoor or other selective application are quite obvious. For example, in food grading and processing, in lithography, engraving and fabric work, in drafting and other close work, color matching and eye comfort demand that the artificial light used give correct color identification. This is possible only when the light under which the work is performed is natural daylight or an artificial light which closely simulates natural daylight.

Many attempts have been made to produce artificial daylight by combining the light outputs of lamps having different spectral characteristics but no construction is known prior to that of the present invention for effectively accomplishing the optimum results desired. Such lamp combinations have frequently achieved rather gross approximations of daylight but have failed in the attainment of thoroughly diffused light mixing of substantially uniform character containing even the subtle or minor daylight constituents. Insufficient or inadequately dispersed light of the green portion of the spectrum has been one of several common difficulties.

Therefore, an object of the present invention is to provide a source of light closely simulating natural daylight.

Another object is to provide a lighting fixture having spectral responsive characteristics closely simulating that of natural daylight both with respect to color and energy distribution.

Another object is to provide a plurality of light sources having individual spectral responsive characteristics which complement each other so that when mixed the combined light is closely simulative of natural daylight.

Another object is to provide an artificial daylight illuminating fixture including a plurality of complementary light sources closely adjacent to a background surface from which light of predetermined characteristics is radiated when the surface is subjected to illumination by said complementary light sources whereby the background surface aids in further complementing the light sources as well as aiding in mixing and diffusing the light from the sources.

Another object is to provide a lamp fixture of the character described which is adaptable to the provision of

precisely predetermined spectral responses whether of daylight character or otherwise.

Further objects are to provide improved elements and arrangements thereof in a choice of the character and for the purposes set forth.

These and other objects will become more fully apparent upon reference to the following description.

In the drawings:

Fig. 1 is a perspective view of a lighting fixture embodying the principles of the present invention.

Fig. 2 is a transverse section through the lighting fixture of Fig. 1.

Fig. 3 is a curve of the color and energy distribution produced from the lighting fixture of Fig. 1.

Fig. 4 is an enlarged fragmentary section of a housing employed in the device of the present invention showing layered coatings applied to a reflective surface thereof.

Referring more particularly to the drawings:

The lighting fixture, generally indicated in the drawings by the numeral 10, includes an elongated housing 11 of sheet metal or other suitable material having an upper or top wall 12, a pair of side walls 13 downwardly extended from closely adjacent to the top wall 12 and a pair of end walls 14 connected to the opposite ends of the top and side walls. The side walls are downwardly divergent from the top wall and each side wall is provided with an upper panel 15 downwardly and outwardly extended from the top wall at a downwardly disposed angle, encompassed therebetween, somewhat less than 180°. Each side wall 13 is further provided with a relatively wider lower panel 16 integral with its respective upper panel 15 and extended downwardly and outwardly therefrom. The lower ends of the side walls 13 are shaped to form a substantially rectangular opening 17 also referred to as a window through which the light produced by the fixture emanates. A louver 18, or any other convenient light diffusing means, is preferably attached in the opening 17 in the housing. As will be more fully described, in some applications of the invention, the louver 18 may be eliminated.

Supported on the top wall 12 and upwardly extended therefrom is a wire closet 23 comprising a substantially U-shaped elongated channel 26 mounted in inverted position on the top wall 12. A cover plate 27 is releasably attached to the channel 26 and provides overhanging edges 28. The side walls 13 are provided with upwardly extended portions 29 spaced from the sides of the U-shaped channel 26 and inwardly disposed from the overhanging end 28 of the cover. The space 30 between each of the upwardly extended portions 29 and the sides of the channel 26 provide ventilating passages connecting the interior of the housing with the atmosphere so that heat generated in the housing may be dissipated.

The housing is provided with an inner surface, generally indicated by the numeral 35, defined by the top, side and end walls. As symbolically represented in Fig. 4 of the drawings, this inner surface 35 of the embodiment shown is coated with a combination of materials which have the ultimate effect of both reflecting light therefrom and also fluorescing when subjected to appropriate incident light. This coating preferably includes an inner layer 37 of baked white enamel which, as will be recognized, provides a highly light reflective surface. An intermediate layer 38 is applied over the inner layer 37 of green fluorescent powder, such as zinc silicate, finely dispersed in a solution of clear lacquer or other substantially transparent applying medium. The composition of the intermediate layer 38 is, of course, mixed prior to its application over the inner layer and the proportions of clear lacquer to green fluorescent powder are such as to separate the fluorescent powder into discrete particles throughout the

lacquer solution and, upon application and drying, to provide a translucent coating. Although green is stated as the type of fluorescent material or powder used, it will be apparent that the invention is not so limited, other colors and combinations of colors being well within the scope of the inventive concept. Further, when it is desired selectively to minimize certain light rays rather than to supplement them, any desired selective light filtering material can be substituted for the fluorescent material. An outer layer 39 of protective water-clear lacquer is applied over the intermediate layer 38 and completes the coating 36. Obviously the layer 39 is entirely optional.

A plurality of incandescent lamps 45 are mounted in substantially equally spaced relation along the top wall 12. Each of the incandescent lamps is provided with an opaque reflective bowl 46 covering substantially the downwardly disposed half of the bulb portion thereof. Silvering such portions of the globe, as is well-known in the art, excellently suits the purpose. The incandescent lamps are mounted in spaced sockets 47 which are connected to the top wall 12. Suitable connection including wiring and the like, generally indicated at 48, is provided in the wire closet 25 in a conventional manner. The incandescent bulbs 45 and the bases 47 therefor extend downwardly in the housing substantially more than half of the depth thereof and, as will be noted in Fig. 2, the bulb portions of the lamps are disposed centrally in the housing both as regards the side walls 31 and also vertically between the top wall 12 and the open bottom 17. The silvered portions 46 are provided on the lamps 45 so that the light emitted therefrom is substantially all directed toward the coated inner surface 35 of the housing.

A pair of elongated, tubular, so-called daylight, fluorescent lamps 55, well-known in the trade, are mounted in the housing in suitable sockets, indicated at 56, in the end walls. Although not shown in the drawings, electrical wiring is of course provided between the sockets 56 and the wire closet 25 for electrical energization of the lamps. The fluorescent lamps 55 are mounted on opposite sides of the incandescent lamps in a common plane parallel to the top wall and super-adjacent to the bowls or bulb portions 46 of the incandescent lamps. The lamps 55 are mounted outwardly from the incandescent lamps and although spaced from both the incandescent lamps and the lower panel portions 16 of the side walls, nevertheless, it is preferred that the lamps 55 be positioned closer to the side walls 13 than to the lamps 45, as seen in Fig. 2. It has been found in the use of this invention, that this positioning of each of the lamps 55 enables a better mixing of the light from all of the sources and portions of the housing as well as preventing the lamps 55 from being unduly influenced by the heat radiated from the incandescent lamps.

A pair of elongated tubular blue-type fluorescent lamps 60 are mounted in suitably provided sockets, generally indicated at 61, in the end walls. As before, suitable wiring, though not shown, is provided between the sockets 61 and the wire closet 25. The fluorescent lamps 60 are disposed on opposite sides of the incandescent lamps 45 and lie in a common plane parallel to the top wall and intermediate the top wall and the plane of the daylight fluorescent lamps 55. The blue fluorescent lamps 60 are mounted in this upwardly spaced position from the daylight lamps 55 since not as much light is required from the former in producing the desired combined light output. Further, it will be noted that the blue fluorescent lamps 60 are mounted inwardly in the housing from the daylight fluorescent lamps relative to the incandescent lamps. Also, the blue fluorescents are spaced from both the upper panel portions 15 and top wall 12 as well as being spaced from the incandescent lamps 45. This manner of positioning again enables the proper mixing of the light emitted from the blue fluorescent lamps with the light emitted from the other sources and portions of the housing. It will be observed that the tubular lamps 55 and 60 preferably lie

on the arc of a cylinder having a center adjacent to the lowermost ends of the incandescent lamps.

It will be readily apparent from the foregoing, that the incandescent lamps, the daylight fluorescent lamps, the blue fluorescent lamps and the green fluorescing powder in the coating 36 are selected in the proper amounts to yield a color and energy distribution curve closely approximating that of natural daylight. The individual spectral responsive characteristics, or otherwise stated, the color and energy distribution curve, of each of the various types of lamps employed as well as the fluorescing powder utilized in the coating 36, must complement each of the other light sources so that the combined result is a spectral response characteristic or curve closely simulating that of natural daylight or other desired light. In the use of the present invention, it has been found that the number and types of lamps employed as well as the relative positioning thereof as above described and as shown in the drawings together with the character of the coating 36 all effect the resultant light output and thus must be carefully selected to attain the desired result.

Operation

The operation of the present invention is believed to be clearly apparent and is briefly summarized at this point. Considering first the incandescent lamp sources 45, it will be understood that substantially all of the light emitted from these lamps is directed toward the coated inner surface 36 and thus insofar as the output of the fixture is concerned, this incandescent light is reflective in character. A certain proportion of the incandescent light close to the ultraviolet region is believed to excite the green fluorescent material but the greater proportion of the light from the incandescent sources is light reflected from the baked enamel inner coating 37.

The light emitted from the daylight lamps 55 is directed outwardly from all sides thereof and thus a portion strikes the coated inner surface 35 and the remainder is directly emitted through the light emanating opening 17 in the housing. The visible light emitted from the daylight fluorescent lamps 55 impinged on the coated inner surface 36 is reflected from the baked white enamel layer 37. However, the ultraviolet light emitted from the fluorescent lamps 55 is turned into usable light since its incidence on the green fluorescent powder in the intermediate coating 38 excites the green powder to fluorescence. Quite clearly, the same general effect is realized from the blue-type fluorescent lamps 60.

It should be recognized that the incandescent lamps 45 produce a light which is quite low in the ultraviolet region and rather heavy in the infrared portion of the spectrum. Complementary to this are both the blue and daylight fluorescent lamps and thus each of these lamps builds up the portion of the curve between 4,000 and 5,000 angstroms. Additionally, the daylight fluorescent lamps 55 build up the central portion of the curve between approximately 5,000 and 6,000 angstroms since the daylight lamps have a color curve quite roughly similar to that of daylight. The green fluorescing powder in the inner surface 35 is only needed in a very small amount in order to smooth out the portion of the curve between about 5,000 and 5,600 angstroms. It has been found that this finely dispersed zinc silicate powder in a clear lacquer solution is highly effective in smoothing out the curve and adds immeasurably to the desired quality of the light output. Inasmuch as the extent of excitation of the fluorescent material is dependent upon the actuating light reaching such material from the light sources 45, 55 and/or 60, the supplemental green added to the overall illumination by the fixture is automatically adjusted in response to dimming or brightening of the electrically energized light sources, as by voltage drop or surge.

While the present invention is particularly suited to

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the simulation of daylight, it will be evident that light of other characteristics can also be simulated, as desired. In a commercial embodiment of the subject invention intended to simulate daylight, four incandescent lamps 45 are employed of seventy-five watts each. These four lamps have a total output of approximately 4,000 lumens. The two lamps 55 are forty watts each and produce a total of approximately 4,230 lumens. The lamps 60 are also each of forty watts but produce approximately 2,350 lumens.

In Fig. 3 the illuminating characteristics of the described embodiment are indicated at 70 in comparison with typical sunlight illumination indicated at 71. Obviously the color characteristics of sunlight vary somewhat due to atmospheric conditions. The standard shown at 71 is usually referred to as Abbott's daylight standard. This is generally regarded as representative of daylight consisting of a total mixture of sunlight and skylight having a color temperature somewhere between 6,000° and 7,500° Kelvin. The close approximation of daylight, represented at 71, by the fixture of the present invention, represented at 70, will readily be appreciated. It will be noted, however, that there is a concentration of light at the positions represented at 72 on the chart of Fig. 3. These are mercury lines which result from the mercury in the fluorescent lamps 55 and 60 and, if regarded as objectionable, may be eliminated by suitable filter means. In practical application, they are normally not objectionable.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices and apparatus.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A lighting fixture for simulating daylight comprising a housing having an elongated concave reflective surface, a translucent coating containing minute, discrete particles of green fluorescent material substantially uniformly dispersed over the light reflective surface of the housing, a plurality of electrically energized incandescent lamps mounted in spaced relation to the reflective surface and in a row longitudinally thereof having light shields positioned to preclude direct light emission therefrom out of the housing and to direct the light therefrom onto the reflective surface, a pair of electrically energized daylight fluorescent lamps mounted on opposite sides of the incandescent lamps in a substantially common plane and intermediate said incandescent lamps and a portion of the reflective surface, a pair of electrically energized blue fluorescent lamps mounted on opposite sides of the incandescent lamps in a substantially common plane in substantially parallel relation to the plane of the daylight lamps and spaced between the plane of the daylight lamps and a portion of the reflective surface, the blue fluorescent lamps being also spaced intermediate the incandescent lamps and a portion of the reflective surface at positions between the incandescent lamps and the daylight lamps on corresponding sides

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of the incandescent lamps, the fluorescent lamps emitting visible radiation directly out of the housing and toward the reflective surface and further emitting ultraviolet radiations toward the reflective surface which strike the particles of fluorescent material to excite such particles so as to emit visible radiation which is substantially homogeneously mixed with the visible radiations from the incandescent and fluorescent lamps.

2. A lighting fixture adapted to produce light of predetermined color and energy distribution in which it is desired to augment the light between 5,000 and 5,600 angstrom units comprising an elongated housing having an internal concave surface, a substantially rectangular opening, and being symmetrical about a predetermined plane extended longitudinally of the housing; a translucent coating including an inner layer of highly reflective material covering the concave surface of the housing, an intermediate layer of minute discrete particles of green fluorescent material substantially uniformly dispersed in a translucent medium and covering the inner layer, and an outer layer of translucent material over said intermediate layer; a plurality of electrically energized incandescent lamps having inner base ends mounted in longitudinally spaced relation in said plane of symmetry on the concave surface of the housing, outwardly extended bowl ends, and light shields in said bowl ends precluding direct light emission from the lamps out of the housing opening and directing such light inwardly toward the concave surface; a pair of inner electrically energized blue fluorescent lamps mounted on opposite sides of and adjacent to the base ends of the incandescent lamps in a substantially common plane substantially perpendicular to said plane of symmetry and adjacent to said concave surface; a pair of outer electrically energized daylight fluorescent lamps mounted on opposite sides of the incandescent lamps in a substantially common plane substantially normal to said plane of symmetry and adjacent to the bowl ends of the lamps, the plane of the daylight lamps being intermediate the plane of the blue lamps and the housing opening, the fluorescent lamps emitting visible radiation directly out of the housing and toward the reflective surface and further emitting ultraviolet radiation toward the reflective surface, said emitted ultraviolet radiation impinging against the particles of fluorescent material to excite such particles to emit visible radiation which is substantially homogeneously mixed with the visible radiations from the incandescent and fluorescent lamps.

References Cited in the file of this patent

UNITED STATES PATENTS

1,004,503	Troy	Sept. 26, 1911
1,150,118	Hewitt	Aug. 17, 1915
1,319,186	Spencer	Oct. 21, 1919
1,943,877	Paget	Jan. 16, 1934
1,959,819	Doane	May 22, 1934
2,169,355	Cohn	Aug. 15, 1939
2,647,985	Biller	Aug. 4, 1953

FOREIGN PATENTS

541,144	Great Britain	Nov. 14, 1941
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