3,165,051

ASPHERATING-TYPE COMBINATION LIGHT AND VENTILATING UNIT

Lee A. Archer, Wheaton, Ill., and Edward M. Caferro, Spokanes, Wash., assignors to The Pyle-National Company, Chicago, Ill., a corporation of New Jersey
 Filed Sept. 22, 1960, Ser. No. 57,757

3 Claims. (Cl. 98—40)

This invention relates generally to a method and apparatus for the diffusion of air and the emission of light into a room from a common fixture wherein a cycle of air at room temperature is powered past a light bulb means in the fixture to operate the bulb at a constant bulb wall temperature, there to avoid color shift and maximizing light output.

Current architectural practices involve the diffusion of ventilating air and the emission of light into a room from a common wall or surface. In response to that practice, there has heretofore been developed so-called combination light fixtures and ventilating apparatus wherein air and light is emitted from a common fixture. Most of such common fixtures utilize so-called fluorescent tube bulbs.

The color of a light source and the color rendering of the light source in such a combination fixture is becoming increasingly important, insofar as the structural and functional characteristics of the fixture are concerned. For example, in evaluating the color performance of a bulb, there are two important factors to be considered; namely, color rendition and color appearance. Color rendition of a light source is the degree to which the perceived colors of objects illuminated from the source conform to those of the same objects illuminated by a reference source for specified viewing conditions. For example, a non-improved color mercury lamp will cause the human complexion to appear greenish.

Color appearance has to do with the apparent color of the light source itself. For example, a daylight fluorescent lamp appears blue by comparison with an incandescent lamp. Color appearance is evaluated numerically and a measuring device known as a colorimeter is an instrument which is in use in the art.

With an ordinary incandescent filament lamp, light is given off as a result of the temperature at which the filament is operated and the color appearance of such an incandescent lamp is a function of the temperature of the filament.

In the case of fluorescent lamps, a fluorescent tube is fundamentally an efficient generator of ultra-violet radiation concentrated at one principal wavelength of 2537 Angstroms. Fluorescent lamps are usually coated on the inside with powders or chemicals capable of transforming the 2537 radiation into longer wavelengths. The explanation of the property of materials which to fluoresce under the action of ultra-violet radiation is simply that such materials absorb energy at one wavelength, re-radiate it at longer wavelengths in much the same manner as a transformer absorbs wattage at one voltage and current, delivers this power energy at a different voltage and current. The re-radiated energy of the fluorescent powders is spread over a considerable range or continuous band of visible wavelengths.

Fluorescent lamps operate most efficiently at ambient temperatures very close to 20° C. Each rise of 20° above this point results in a decrease in brightness (i.e., light output) of approximately 10%.

Variations in ambient temperature have been found to have not only an appreciable effect on the efficiency of fluorescent lamps, but also upon the color thereof. Thus, in an installation of fluorescent lamps in an air conditioned store, the lamps immediately in front of the cold air inlets may appear off color and dim compared to the rest of the lamps in the lighting system.

This phenomenon is especially critical in the successful use of combination lighting-air distributing fixtures. For example, in a system wherein a false ceiling is provided and a supply duct extends into the space behind the false ceiling and the ceiling is provided with a plurality of openings formed therein receiving fluorescent troffer lights, only a selected number of the troffer lights may be equipped as a combined lighting-air distributing fixture. If the supply air passing through the light fixture significantly affects the operating ambient of the fluorescent tube, a perceptible color shift may occur with the result that the fluorescent tubes in the troffer used as an air outlet might appear quite different in color than the same fluorescent tubes in the non-ventilating troffer unit.

The problem thus presented can be overcome only by operating all of the fluorescent tubes in the entire system at an optimum operating temperature range so that no perceptible color shift will occur even though one or more of the troffer light units may be utilized as an air outlet.

In accordance with the principles of the present invention, it has been observed that "room air temperature" is a substantially constant value. By that term, it is meant the temperature of the air within the room being illuminated and ventilated. In most spaces occupied by humans and served by a ventilating system following current practice, the room air may vary in temperature only 2 or 3° F. at most.

Moreover, in an operating environment, the room air temperature is always lower than the bulb wall temperature of the fluorescent tube. Further it has been observed that the bulb wall temperature must be maintained substantially constant because a color shift will occur if the temperature varies by as little as 9° F.

It is, therefore, contemplated by the present invention to use the flow of supply air in a method and apparatus of diffusing air and emitting light into a room from a common fixture to power a cycle of room air past the light source or fluorescent bulb to operate the bulb at a constant bulb wall temperature, thereby to avoid color shift and maximizing light output.

It is an object of the present invention, therefore, to provide a method and apparatus of diffusing air and emitting light into a room from a common fixture wherein there will be a minimum perceptible color difference.

Another object of the present invention is to provide a combination ventilating-lighting fixture wherein color shift is minimized and light output is maximized.

Another object of the present invention is to provide a fixture wherein a fluorescent bulb may be operated as close as possible to its designed color.

A further object of the present invention is to provide a combined ventilating-lighting fixture wherein a controlled limited aspiration of air at room temperature may be promoted past the bulb, thereby to maintain the bulb at an optimum operating temperature.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon reading the detailed description which follows and the accompanying drawings in which two different structural embodiments of a fixture are described to illustrate the application of the principles of the present invention.

On the drawings:

FIGURE 1 is a fragmentary perspective view showing a combination lighting and ventilating system for an architectural structure and which utilizes a method and apparatus in accordance with the principles of the present invention wherein air is diffused and light is emitted from a common fixture;
FIGURE 2 is a cross-sectional view taken on line II—II of FIGURE 1 and illustrating one form of troffer-type fixture embodying the principles of the present invention;

FIGURE 3 is a cross-sectional view taken generally on line III—III of FIGURE 2 but reduced in size to show additional details of construction of the fixture of FIGURE 2;

FIGURE 4 is a cross-sectional view taken substantially on line IV—IV of FIGURE 2 and shows additional details of construction of the vanes;

FIGURE 5 is a view similar to FIGURE 2 but showing another form of troffer unit embodying the principles of the present invention;

FIGURE 6 is a cross-sectional view, the left-hand portion being on line A—A of FIGURE 5 and the right-hand portion being on line B—B of FIGURE 5.

As shown on the drawings:

Although the principles of the present invention are applicable to any fixtures wherein air and light is to be distributed from a common unit, the principles of the present invention are illustrated specifically in connection with an architectural installation shown in FIGURE 1 as including a ceiling 10 below which is constructed a false ceiling 11 providing a finished surface 12 which is exposed to the interior of a room or space intended to be occupied.

Extending into the space between the false ceiling 11 and the ceiling 10, there is provided a ventilating duct 13 connected to a source of ventilating air at increased pressure and which source of ventilating air can include temperature conditioning, either heating or cooling, or both.

The false ceiling 11 is provided with plural spaced openings or rows of openings and into which openings are inserted fluorescent troffer lights. For example, as shown in FIGURE 1, there is provided three separate rows of troffer lights at E, F and G. In row E the three separate troffer units shown in that fragment appearing in FIGURE 1 include a unit shown at E1, and second unit at E2, and a third unit at E3. Likewise, in the row designated at F, there is provided a unit F1, a second unit at F2, and a third unit at F3. Lastly, in row G there is provided a first unit at G1, a second unit at G2, and a third unit at G3.

In accordance with the principles of the present invention, one or many of the troffer units can be adapted to function as a combined air distributor and lighting trough. In the present instance, it is assumed that the unit E1 and the unit F1 are such combined fixtures. Thus, there is attached to each of the units E1 and F1 a flexible tube 14E and 14F, the other end of which in each respective instance is connected to a corresponding opening formed in the main ventilating duct 13. Thus, a supply of ventilating air is diffused into the space beneath the false ceiling 11 through the air distributors or air outlets formed by the units E1 and F1.

Referring now more particularly to FIGURE 2, it will be noted that the details of each of the units E1 and F1 are shown in greater detail. First of all, there is provided a casing or troffer housing shown generally at 16. Although the troffer housing may comprise any convenient trough-shaped apparatus, in the form of the invention illustrated in FIGURE 2 the housing 16 assumes the shape of a conventional fluorescent troffer light housing and includes a mounting flange 17 adapted to be connected to the adjoining edges of the openings in the false ceiling 11. The housing further includes an upwardly and inwardly extending side wall portion 18, there being a similar side wall portion 18 on each side of the housing 16 and each terminating in a vertically extending wall 19, the vertically extending walls 19, 19 being joined by a horizontally extending wall 20.

Forced within a center portion of the top wall 20 is an opening 21 in which is received a duct 23 forming an inlet 23. The duct 22 carries a bracket 24 in which is threaded a bolt 26 connected to a control valve 27 where-by the size of the inlet 23 may be selectively adjusted to regulate the flow of air into the fixture.

Internally of the fixture and subjacent the inlet 23, there is provided a transversely extending baffle or wall 28 against which inlet air impinges. It will be noted the wall 28 extends across a major portion of the fixture near the lower extremities of the vertical side walls 19. Thus, the side walls 19 together with the transversely extending wall 28 forms a plenum 29 to which air is supplied under pressure from the supply duct 13 via the flexible duct 14E or 14G. Impingement of the incoming air into the plenum 29 against the baffle or wall 28 insures that the air will not be forcibly directed directly into the space.

Attached to the wall 28 there is provided a reflector wall shown generally at 30 and which is of an irregular configuration. First of all, there is a center body portion 31 which is spaced below and away from the wall 28 and which center body portion 31 is generally parallel with the wall 28.

Secondly, there is a side wall 32 and a side wall 33 which extend upwardly and outwardly away from opposite sides of the center body portion 31. At the upper extremity of each portion 32 and 33, there is provided a bracket 32. At the extremity of each portion 34 and 35, there is provided an angularly offset wing at 36 and 37, respectively. Each respective wing extends in a generally depending direction and is spaced inwardly of an adjoining side wall 18, thereby to form a light passage identified in each instance by a common reference 38. Thus, the passages 38, 39 lead from the plenum 29 into the trough developed by the side walls 18.

Attached at opposite ends of the fixture and to the bracket wall portions 34 and 35 are fluorescent sockets 40 and 41 for holding and energizing a pair of fluorescent light bulbs 42 and 43. It will be noted, therefore, that the arm portion 32 in cooperation with the bracket wall 34 and the wing portion 36 is spaced behind the fluorescent tube or bulb 42 and, in effect, forms a small reflector trough since the surface of such wall portions, as shown at 44, may be appropriately finished or coated to enhance the reflective properties thereof.

Likewise, the inclined portions provided by the arm 33 and the wing 37, in cooperation with the bracket wall 35, forms a small trough behind the fluorescent bulb 43 and that surface is also made to be finished or coated at 45 to enhance the reflective properties thereof.

The troffer unit shown in FIGURE 2 is of the type sometimes referred to in the trade as a low brightness troffer. Such units are oftentimes provided with a so-called "egg crate" louver assembly.

In accordance with the principles of the present invention, the louver assembly incorporated in the unit of FIGURE 2 has a plurality of cross pieces 47 each carried by a generally V-shaped rib shown generally at 48 and including spaced divergent legs 49 and 50 which diverge outwardly from an apex 51 in a gently curving slope so as to merge and form an extension of the walls 32 and 33, respectively. The outer surfaces of the legs 49 and 50 may be finished or suitably coated to enhance the reflective properties thereof.

As shown in FIGURES 2 and 3, the center body wall 31 carries a pair of spaced hook brackets 52. The rib 49 has its legs 49 and 50 slotted at as 53, whereby to receive a pin 54 spring-biased by a continuous biasing means 56. By grasping opposite ends of the pins 54 positioned in spaced relationship on the rib 48 and pulling the pins 54 through the bias of the springs 56, the entire louver assembly may be simply snapped in place or disassembled from the fixture.

In connection with the principles of the present invention, it is important to note that there is provided what amounts to a heat exchange surface and which is formed by the leg 49 and the arm 32 insofar as the bulb 42 is concerned and by the leg 50 and the arm 33 insofar as the bulb 43 is concerned.
It has already been noted that air entering the plenum 29 impinges against the baffle or wall 28. To further assist in diffusing the outward flow of air from the plenum 29 through the trough formed by the housing 18, there is provided a special vane construction which is intersected in each respective air flow passage 38. The vane construction is shown generally at 60 and comprises what may be referred to as a honeycomb construction including a pair of longitudinal members 61 to which are connected a plurality of transversely extending blades or vanes. All of the blades or vanes cooperate to produce a specific effect on the flow of the air outwardly through the passages 38, 39. Thus, the individual vanes are given individual offsets so that the air flow pattern will be controlled to best suit the characteristics of the unit. For example, in an exemplary construction, each of the blades or vanes at one end of the vane construction 60 are offset as at 62 to an angle H which may comprise an angle of 45°. Moving towards the other end of the vane construction, it will be noted the vane indicated at 63 is offset to an angle I which may be 20°. The number of series of vanes, shown at 64, are offset to an angle J which may be 17° and the following series of vanes shown at 66 are offset to an angle K which may be 15°. All of the foregoing blades are inclined in the same manner with one another control the endwise velocity components and actually restrict outward flow of the central portion so that a uniform air flow pattern is promoted as the air is displaced outwardly from the plenum 29. Moreover, by placement of the vane construction 60 in registering with the passage 38 and inclined at an angle shown on FIGURE 2 at N of approximately 30°, the air after it has impinged against the baffle or wall 28, is required to virtually surmount the vane construction 60, thereby reducing entrainment and producing a motion which is believed to be in the nature of a swirling action shown in FIGURE 2 by the swirl pattern identified by the lines and arrows bearing the reference numeral 70. The "swirl" 70 scrubs the outside wall 18 but entrains a minimum or small amount of air from the adjoining lamp chamber prescribed between each respective outside wall 18 and the inside walls 30, 33 or 49, 32.

The swirl out of each respective passage 38 occurs adjacent the end of each respective wing 36 and 37. According to the minimum or small amount of air from the lamp chamber entrained by the swirl operates to aspirate a small flow of air past the respective bulbs 42 and 43. More specifically, it is contemplated that the present invention that the flow or swirl 70 of supply air will power a cycle of air at room temperature past the bulbs 42 and 43 to operate the bulbs 42 and 43 at a constant bulb wall temperature. In the figure of FIGURE 2, the air at room temperature is below the level of the false ceiling and hence below the level of the fixture. The aspiration which occurs results in air at room temperature moving upwardly along the legs 49 and 50 in the direction of the arrows 71.

Inwardly of the legs 49 and 50, the rib 48 prescribes the confines of a dead air space 72. The dead air space is open at opposite ends to air at room temperature. Between the wall 28 and the structural member 31-37, there is a completely dead air space 73. The space 73 is sealed off at opposite ends by plugs shown on FIGURE 3 at 74.

Since a color shift will occur if the bulb wall temperature varies by as little as 9°, the promotion of a control limited aspiration of air at room temperature past the bulbs 42 and 43 and which room air is preheated along the heat exchange surfaces provided by the legs 49 and 50, the bulbs 42 and 43 are maintained at an optimum operating temperature. Thus, color shift is avoided and light output is maximized. The glass bottom unit of FIGURES 5 and 6 will be described by the use of comparable reference numerals bearing the suffix "a." Thus, there is provided a housing shown generally at 16a including a flange portion 17a which is adapted to be connected to the edges of an opening in the false ceiling 11. A first side wall portion is shown at 18a and a vertically extending side wall portion is shown at 19a terminating in a horizontal wall portion 20a. An opening 21a formed in the top wall 20a receives a duct 22a forming an inlet 23a controlled by a valve 27a regulated by a turn bolt 26a. Extending transversely of the fixture and spaced below the top wall 20a is a baffle or wall 28a, thereby to form within the fixture a plenum 29a receiving air at increased pressure from a source of ventilating air.

A structural member shown generally at 30a includes a center body portion 31a and extending blades inclined from the wall or baffle 28a. Upwardly inclined arms at 32a and 33a are located on opposite ends of the center body portion 31a and there is further provided a bracket wall shown at 34a and at 35a. Depending generally downwardly from the extremities of the bracket walls 34a and 35a are side walls 36a and 37a. Attatched to the bracket wall are fluorescent bulb sockets shown at 40a and 41a, thereby to mount and energize fluorescent tubes or bulbs 42a and 43a.

An auxiliary wall 76 is carried on each side of the fixture and forms an extension of the wall portion 18a, thereby to provide a diffusion slot or passage 77 which has a narrow throat 78 and which diverges downwardly and outwardly of the fixture. At a lower portion of the diffusion slot 77 there is provided the vane construction 60a for promoting the uniform distribution of air outwardly from the fixture. At the bottom end of the walls 36a and 37a, there is provided a clip bracket 79 which fastens to the adjoining outside wall 18a and which cooperates with a second bracket 80 to retain a glass plate 81 extending across the bottom of the fixture and closing the lamp compartment shown at 82.

In accordance with the principles of the present invention, each of the walls 36a and 37a is provided with a plurality of aspiration openings 83. As shown in FIGURE 6, there are five aspiration openings in each wall 36a and 37a and such openings are conveniently provided by striking out a portion of each wall, thereby to provide a lug 84 which extends inwardly into the lamp compartment 82 forming a throat 86 which communicates the lamp compartment with the diffusion slot 77.

The lamp compartment 82 is provided with additional openings at opposite ends thereof. Thus, the fixture has an end wall 87 and an end wall 88. Formed within the end wall 87 is an aspiration inlet opening 89 and formed within the end wall 88 is an aspiration inlet opening 90. As described in connection with the fixture of FIGURE 2, air entering the inlet 23 impinges against the baffle 28, as shown by the arrows and then passes through the vane construction 60. Likewise in the arrangement of FIGURE 5 the air passing through the inlet 23a impinges against the baffle 28a, as shown by the arrows, and is directed outwardly through the diffusion slots 77 past the aspiration openings 83. Thus, a small amount of air is aspirated from the lamp chamber and air at room temperature will enter the lamp chamber 82 through the openings 89 and 90 and will pass along a substantial length of the lamp chamber before outward movement thereof through the throat 86 of the slot 83.
There is again provided, therefore, the control limited aspiration of air at room temperature past the bulbs 42a and 43a and such air is, in effect, preheated by virtue of its passing through the substantial portion of the lamp compartment 82 so that the bulbs 42a and 43a are maintained at an optimum operating temperature to avoid color shift and to maximize light output.

Although minor modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent warrant hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

We claim as our invention:

1. A fixture for diffusion air and emitting light into a room comprising a double case shell having inner and outer walls forming a light compartment and a plenum for receiving a supply of air from a source at increased pressure, a fluorescent lamp in said light compartment, said walls of said double case shell terminating in a common plane at the lower free ends thereof to form a light egress for said light compartment and a diffusion outlet for said plenum, said inner wall formed with an aspirating opening means located above and one side of said fluorescent lamp, said aspirating opening means drawing room air through said light compartment and mixing with the air discharged from the plenum to the outlet.

2. A fixture for diffusing air and emitting light into a room comprising a troffer housing having walls forming a lower light trough and an upper plenum for receiving air from a source at increased pressure and further forming air flow passages alongside said light trough, a fluorescent lamp in said light trough, a glass bottom for said light trough forming a light egress, means forming an outlet for said air flow passages at the plane of said glass bottom, and aspirating opening means above and to one side of said lamp, said troffer housing having aspiration inlet openings admitting room air into said light trough, said aspirating opening means drawing room air through said aspiration inlet openings and through said light trough and mixing the aspirated room air with the air discharged through said air flow passages, thereby to operate said fluorescent lamp in the light compartment at a constant bulb wall temperature.

3. A fixture for diffusing air and emitting light into a room through an opening in a false ceiling for the room comprising, a troffer housing having walls forming a lower lamp compartment and an upper plenum for receiving a supply of air from a source at increased pressure, a pair of fluorescent lamps in said lamp compartment, said walls including side walls terminating in a common plane coincident with said false ceiling, and inner wall means forming with said side walls discharge passages for discharging air from said plenum along opposite sides of said light compartment and into said rooms, said lamp emitting light out of the bottom of said lamp compartment into said room, said inner wall means forming aspirating opening means above and to one side of each said fluorescent lamp for drawing room air through said lamp compartment and mixing with the air discharged from said plenum, and a light diffusion means in the bottom of said lamp compartment comprising an egg-crate louver assembly having a V-shaped rib extending between said lamps and including spaced divergent legs to direct room air aspirated through said lamp compartment along the legs and past the fluorescent lamps, whereby to operate said fluorescent lamps at a constant bulb wall temperature.

References Cited in the file of this patent

UNITED STATES PATENTS

2,255,849 Kurth September 16, 1941
2,282,587 Kurth May 12, 1942
2,845,855 Burns August 5, 1958
2,960,602 Kurth et al. November 15, 1960
2,985,090 Quinn May 23, 1961
3,004,142 Archer October 10, 1961
3,065,686 Geocaris November 27, 1962