May 8, 1956 E. F. GUTH 2,745,001

LIGHT DIFFUSORS FOR ILLUMINATING DEVICES

Filed Dec. 15, 1951

FIG.1.

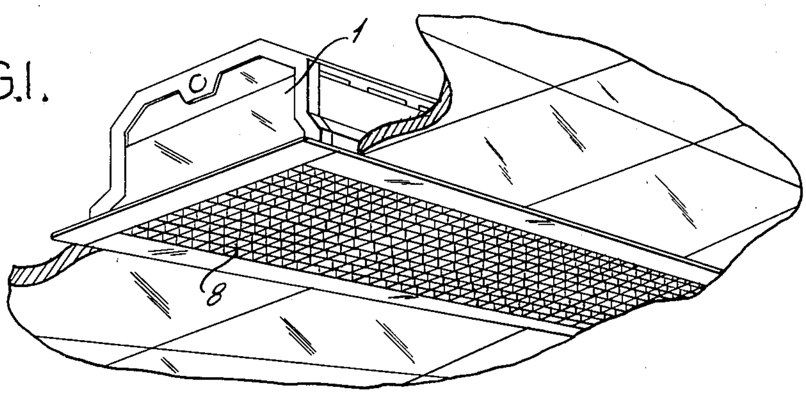



FIG.2.

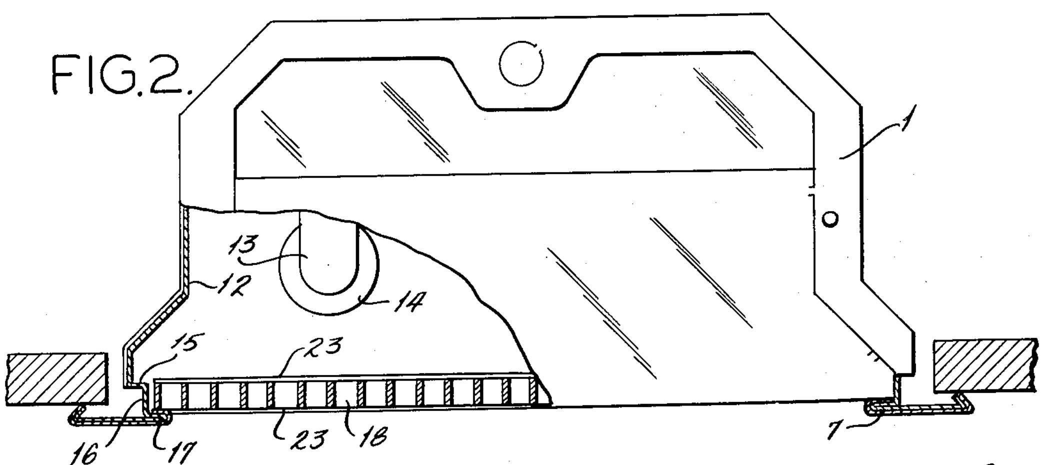



FIG.3.

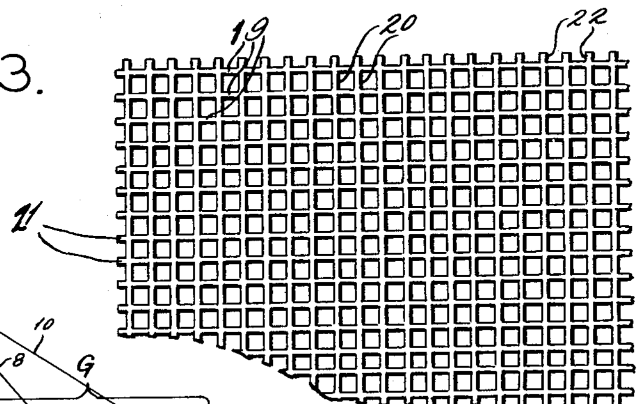
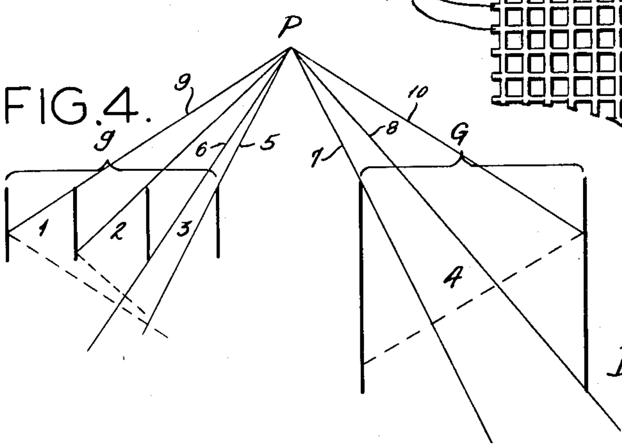



FIG.4.




INVENTOR:
EDWIN F. GUTH
By Brumiga and Sutherland
ATTORNEYS.

United States Patent Office

2,745,001

Patented May 8, 1956



2,745,001

# LIGHT DIFFUSORS FOR ILLUMINATING DEVICES

Edwin F. Guth, St. Louis County, Mo.

Application December 15, 1951, Serial No. 261,780

4 Claims. (Cl. 240—78)

This invention relates generally to the diffusion of light, and particularly to diffusion grids for use in connection with lighting fixtures and in other situations where it is desired to diffuse light between the source thereof and the region upon which the illumination is desired.

It is common practice, particularly with fluorescent lighting fixtures, to apply a diffusion grid, or so-called "egg crate," over the mouth of a lighting fixture in which the source of light is encased, so that light emanating from said source must pass through the grid before reaching the region desired to be illuminated. Such diffusion grids are generally composed of a lattice of panels defining vertical passageways having open apertures at their upper and lower ends and arranged below the source of light in or near the ceiling of a room to be illuminated. It has heretofore been recognized that, when the passageways or such a grid are cubic, the source of light above the grid cannot be directly seen by an observer whose line of vision toward the source makes an angle of less than 45° with the horizontal. Thus, direct rays from the source of light are cut off by such a grid except within a zone where the light rays make an angle of more than 45° with the horizontal. Such cutting off of the direct rays from the source of light is highly desirable for ease upon the eyes of persons situated in the illuminated region, and it is desirable, therefore, to cut off as much of the direct light as possible in order to minimize the possibility that such persons may inadvertently address their line of vision in a direction such as to expose their eyes to direct rays from the source.

Heretofore, grids of the character referred to have been formed of a variety of materials, both opaque and translucent, but it is recognized that the material of which the grid is made is preferably an imperfect reflector, as otherwise the desired reduction of glare is not accomplished. It has been the practice heretofore to form such grids so that the apertures thereof were on the order of an inch or two square. With apertures of such size, and where it is desired to cut off direct visibility of the source at an angle of 45°, it is necessary that the grid be made of a vertical dimension no less than its transverse dimensions. The latter condition requires either that the grid extend for a substantial distance below the fixture or that the fixture be made inordinately deep to accommodate the grid below the light source therein.

The object of the present invention, generally stated, is to provide a light diffuser of the grid type having improved illumination characteristics.

At the outset, it was my objective to provide a grid which was less space-consuming than the grids heretofore provided, without sacrifice of any beneficial result, but in the pursuit of that objective, I discovered that improved illumination characteristics were also achieved.

Other objects will become apparent to those skilled in the art when the following description is read in connection with the accompanying drawings, in which:

Figure 1 is a perspective view of an illuminating device provided with a light diffusor constructed in accordance with the present invention;



Figure 2 is an end view of the device shown in Figure 1, part being shown in section to reveal the relationship of the elements;

Figure 3 is a plan view of the light diffusor shown in Figures 1 and 2; and

Figure 4 is a diagram illustrating the effect of the light diffusor of the present invention.

The present invention is predicated upon the discovery that light-diffusing grids or lattices, of a plastic translucent material, viz., a synthetic resin, and having substantially cubic apertures, which are between a quarter and a half inch on a side, improve the character of illumination over grids wherein similarly shaped apertures have a size of an inch or more on a side, in accordance with the prior practice in the art, or even of a size three-quarters of an inch on a side. The character of illumination is improved in several aspects, notable among which are reduction in glare, decreased loss of light in passing through the grid, and therefore higher illumination and brightness, reduction of the field in which the light source is directly visible through the grid, and an improved distribution of the light passing through the grid at varying angles from nadir and within the zone of a person in a room illuminated.

While the theory of operation of applicant's light diffusor is not essential because of the structure thereof described and claimed, the following may be observed: A given grid area composed of a plurality of such small apertures passes considerably less light directly from the light source and more once-reflected (as distinguished from two-or-three-times-reflected) light than the same grid area composed of apertures several times as large. This is diagrammatically illustrated by Figure 4, in which P is a point source of light emitting oblique rays through a small-apertured grid on one side and a large-apertured grid on the other side. The gross area *g* of small-apertured grid (consisting of three cubic apertures **1**, **2**, and **3**) is the same as the gross area G of large-apertured grid (consisting of a single cubic aperture **4**). Grid areas *g* and G are symmetrically positioned with reference to source P so as to receive oblique rays emitted by said source. Light rays between lines **5** and **6** of grid *g* pass directly through aperture **3** of the small-apertured grid, but no light rays pass directly through (i. e. without reflection) apertures **1** and **2**. Likewise, light rays between lines **7** and **8** of grid G pass directly through aperture **4**. It is apparent that the angularity of line **7** of grid G is identical with that of line **5** of grid *g*, but that line **8** is of greater obliquity than line **6**, so that the area of a working surface illuminated by direct light rays passing through given area G is several times that which is illuminated by direct rays passing through given area *g*. Moreover, it will be observed that light rays in the position indicated by line **9** of grid *g* reach the region below the small-apertured grid with but one reflection, whereas light rays symmetrically positioned, as shown by line **10** of grid G, require to be reflected twice in passing through aperture **4** before reaching the region below the large-apertured grid. Each such excess reflection involves loss of light, the more so when the apertures are defined by materials which are purposely imperfect reflectors. Furthermore, the amount of material required to manufacture a given area of small-apertured grid is less than that required to manufacture the same area of large-apertured grid.

Comparing, for example, a louver having cubic apertures ⅜ inch on a side with a corresponding louver having cubic apertures ¾ inch on a side, each louver having walls 1/16 inch thick and each made of a translucent synthetic resin, such as a molded polystyrene; the areas of the walls of four ⅜ inch cubicals will be the same as one

¾ inch cubical. Again in such a case the angle corresponding to Fig. 4, 5–P–6 of the ⅜ inch cubical will be substantially less than the angle 7–P–8 of the ¾ inch cubical, so that the ¾ inch cubical will pass more direct light and will involve undesirable reflection as compared to the ⅜ inch cubical, and that will be the condition over a considerable range from nadir and beyond 45°, of light projected into a room where, for instance, the louver and its lamp are on a ceiling of the room. Furthermore, the light from the lamp will be more uniformly distributed by the ⅜ inch louver than by the ¾ inch louver, even in the zone within 45° from nadir and beyond 45°. It appears that with a ⅜ inch louver, the light from the lamp striking the louver walls will be dispersed downwardly and more uniformly than is the case with the ¾ inch louver. While with both louvers the illumination in foot candles and the brightness in foot lamberts decrease progressively from nadir to for example 70°, both illumination and brightness are maintained to a substantially greater extent with a ⅜ inch louver than with a ¾ inch louver. The distribution of light projected from a ⅜ inch louver is substantially improved as compared to the light projected from a ¾ inch louver, to such an extent that from near nadir to even 45° and beyond, the lamp does not directly appear to the person viewing the louver at various angles, except as it appears through or by dispersion, refraction or reflection from the louver walls. The latter effect is important from the standpoint of glare.

Referring now to Figures 1, 2, and 3 for an illustrative embodiment, the light diffusor of the present invention is shown in combination with a fluorescent lighting fixture **11** of the recessed type. The fixture consists of a canopy **12** enclosing one or more sets of receptacles **13** for the reception of bulbs **14**, together with other well known accessories. The lower peripheral edge of the canopy is, in accordance with the usual practice, provided with an inwardly and downwardly offset seat for the reception and support of a diffusor. In the embodiment shown, the diffusor seat is formed by inturning the edge of the canopy at **15**, downturning it at **16**, and inturning it again at **17**. The inturned portion **17** supports the diffusor **18** when in position, while the downturned portion **16** confines the diffusor in the lateral direction, permitting slight freedom of movement. The inturned portion **15** provides a space laterally outward from the downturned portion **16**, by which the diffusor may be maneuvered into position from below to above the inturned portion **17**, despite the fact that the lateral dimension of the diffusor is substantially greater than the distance between the innermost edge of inturned portion **17** and its companion inturned edge on the opposite side of the canopy.

The diffusor of the present invention consists essentially of a louver in the form of a grid or lattice in which the apertures are substantially cubic and have a dimension between a quarter and a half inch on a side, preferably three-eighths of an inch. The several apertures are bounded and defined by parallel lateral strips **19** and parallel longitudinal strips **20**. The several strips **19** and **20** thus constitute the vertical faces of the respective apertures. The thickness of the strips or walls **19** and **20** is preferably no greater than that sufficient to give the structure adequate mechanical strength. In an illustration, the strips have a thickness on the order of one-sixteenth of an inch. While the several strips or walls **19** and **20** may be formed of any suitable material and interconnected in any desired way, it is preferable to mold the structure integrally and to form it of a synthetic resin, viz., a thermoplastic material which is translucent, though not transparent. Suitable thermoplastics for such purpose are polystyrene, one commercially known as Lucite, vinyl, vinylidene, acrylate, plastics, and other comparable materials which lend themselves to molding by the usual techniques. Such grids may be formed of any desired size, such as the size standard in the industry, namely, 10½ x 48 inches, it being important only that the width of the grid be sufficient to extend between and overlap onto oppositely disposed seats **17** of the fixture with which the device is to be used. In an illustrative embodiment, the lateral strips **19** extend outboard beyond the endmost longitudinal strips **20**, as shown at **21**, and likewise the longitudinal strips **20** extend outboard beyond the endmost strips **19**, as shown at **22**. Preferably, the outboard extension of the strips is for a distance corresponding to one-half the dimension of the apertures in the grid. The latter is particularly important in connection with the longitudinal strips of grids which are to be used in continuous fixtures whose length exceeds that of the grid. In such cases, two pieces of grid may be arranged in endwise abutment so that the extensions **22** of adjacent pieces of grid together define a series of apertures.



In an illustrative embodiment, the grid is provided on opposite sides thereof with a cover film **23**. The cover film **23** is preferably transparent and may be formed of any appropriate material which may be readily adhered to the grid, and whose coefficient of thermal expansion is not sufficiently different from the material of the grid to break the adhesion as an incident to thermal expansion and contraction. Cellophane, Saran, and other flexible transparent film materials of commerce are well adapted for the purpose. It is important in this respect that, while the cover film when employed be adhered continuously from end to end of the several strips **19** and **20**, and on both sides thereof, the film be sufficiently flexible to yield, without breaking its adhesion, upon expansion and contraction of the air which is entrapped in the several apertures.

Alternatively, one of the cover films may be molded integrally with the cross strips of the grid. In such cases it is preferable that the material have a higher factor of transparence than otherwise, in order to diminish the loss of light. Most of the transparent moldable plastics sufficiently refract light that a small apertured grid made thereof accomplishes the desired result, particularly when the apertures are provided with one integral cover as aforesaid. Other plastics may be dipped in or treated with solvent or other suitable material so as to render the crosspieces of the grid opalescent or opaque, without so treating the cover pieces.

Regardless of whether the cover films are utilized, grids whose apertures are substantially cubic and dimensioned on the order of three-eighths of an inch, or generally between one-fourth and one-half inch, efficient in light transmission, more effective to reduce glare, and more restrictive of direct visibility of the source than grids whose apertures are substantially larger. Moreover the fact that the grid is less space consuming than larger ones with cubic grids makes possible a reduction in the depth of the fixture in which they are used and of headroom in a room in which they are used. And withal, less material is required for the manufacture of the small cubic apertures than for larger ones.

While the diffusor has been shown and described as provided with cover films on both sides of the grid, it is to be distinctly understood that one or both such cover films may be dispensed with, without loss of advantage from the standpoint of illumination and brightness. In the ordinary situation where the structure is used as the diffusor in a lighting fixture of the character hereinabove described, a principal advantage of the cover films is to eliminate the tedium of cleaning the interiors of the apertures. Where it is desired to provide a sound-deadening effect within the illuminated region, the cover film on the lower side of the diffusor may be eliminated, thus making use of the several apertures in the grid for the dual purpose of diffusing light and deadening sound and for ease in cleaning and ventilation.

From the foregoing description, those skilled in the art should readily understand the construction and mode of operation of the invention and realize that it accomplishes its objects. While one complete embodiment has been disclosed in detail, it is not to be understood that the invention is limited to that embodiment. Various modifications and adaptations of the invention, within the scope of the claims, will become apparent to those skilled in the art, and it is to be understood that such modifications and variations as do not depart from the spirit of the invention are, although not specifically described herein, contemplated by and within the scope of the appended claims.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. A light diffusor comprising a lattice of translucent strips arranged to define between them a multiplicity of substantially cubic apertures, said apertures having a dimension of one-quarter to one-half inch on a side.

2. A light diffusor comprising a lattice of translucent strips arranged with their planes generally normal to the plane of the lattice to define between them a multiplicity of cubic apertures, said strips having a thickness of the order to one-sixteenth of an inch and a width of three-eighths of an inch, the spacing between the strips also being of the order of three-eighths of an inch.

3. A light diffusor, comprising an integral molded lattice of translucent plastic material defining between the walls thereof a multiplicity of substantially cubic apertures whose dimensions are from one-quarter to one-half inch on a side and the thickness of the walls being on the order of one-sixteenth of an inch.



4. A light diffusor, comprising an integral molded lattice of a translucent synthetic resin defining between the walls thereof a multiplicity of substantially cubic apertures whose dimensions are from one-quarter to one-half inch on a side and the thickness of the walls being on the order of one-sixteenth of an inch.


**References Cited in the file of this patent**

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,989,931 | Johnson | Feb. 5, 1935 |
| 2,005,531 | Brandstein | June 18, 1935 |
| 2,258,354 | Doane | Oct. 7, 1941 |
| 2,305,722 | Livers | Dec. 22, 1942 |
| 2,329,268 | Heath | Sept. 14, 1943 |
| 2,341,895 | Beck | Feb. 15, 1944 |
| 2,398,624 | Decker | Apr. 16, 1946 |
| 2,440,603 | Guth | Apr. 27, 1948 |
| 2,579,015 | Schoenbrod | Dec. 18, 1951 |
| 2,607,455 | Yellin | Aug. 19, 1952 |

OTHER REFERENCES

"Recessed Lighting Equipment," Curtis Lighting, Chicago, Ill., page XR–113, copyright 1938.