April 16, 1946. T. W. ROLPH 2,398,507

DOWN LIGHTING APPARATUS

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Fig. 1.

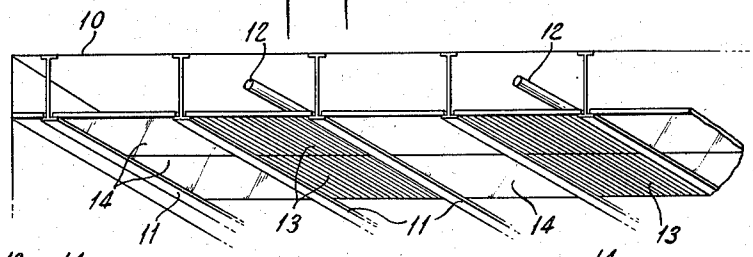
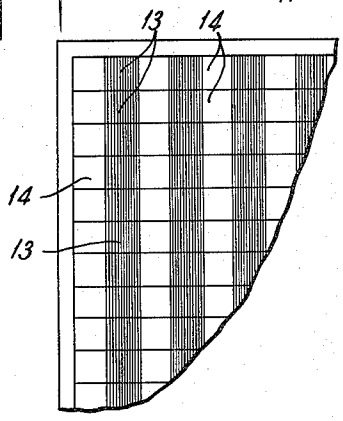


Fig. 2A.



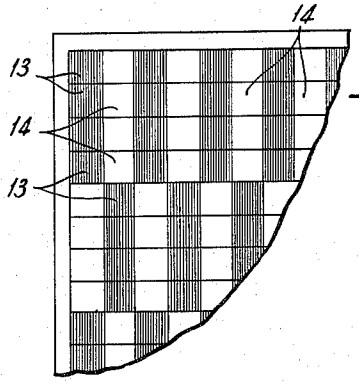


Fig. 2B.

Fig. 2C.

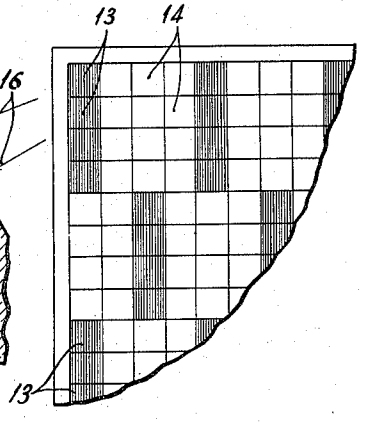


Fig. 4.

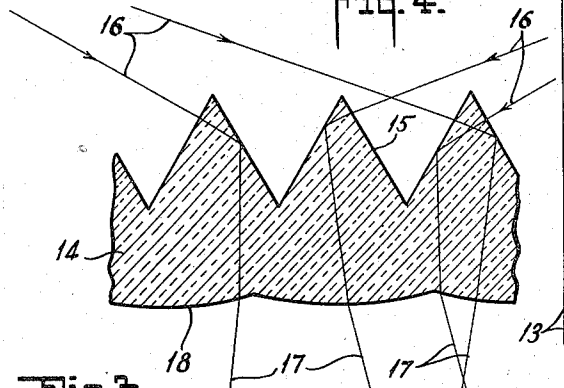
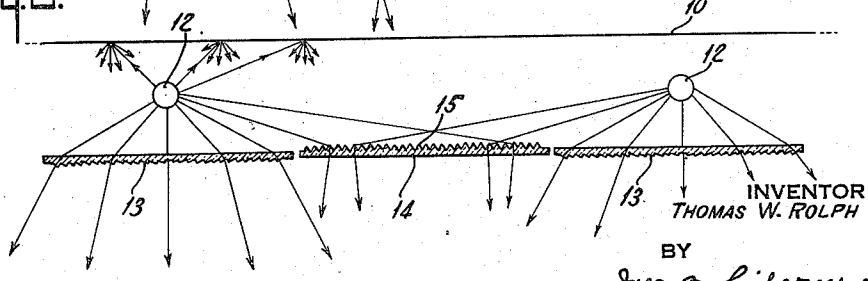


Fig. 3.



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DOWN LIGHTING APPARATUS

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Fig. 5.

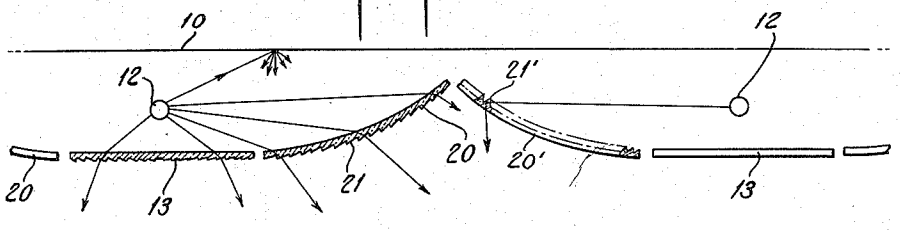


Fig. 6.

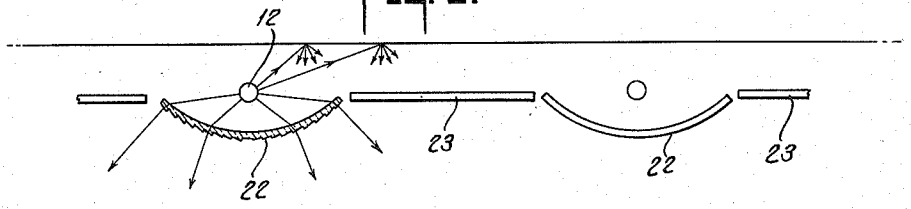


Fig. 7.

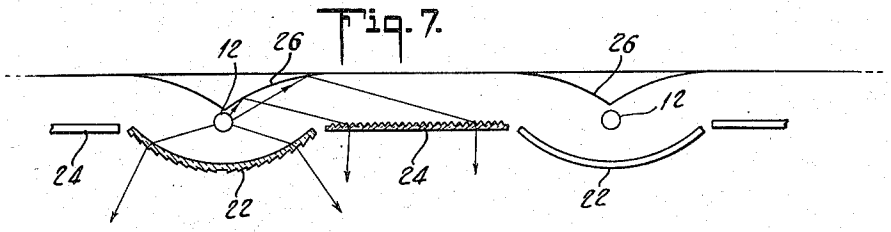


Fig. 8.

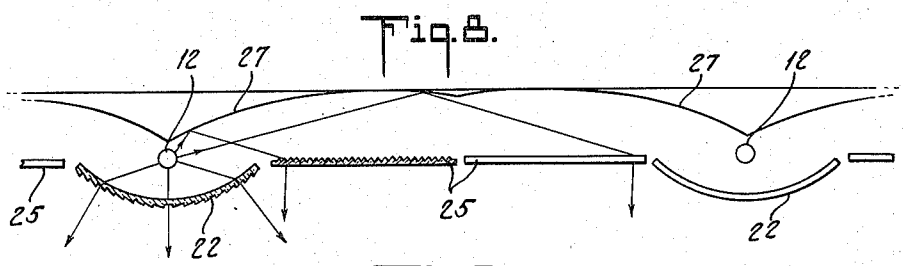
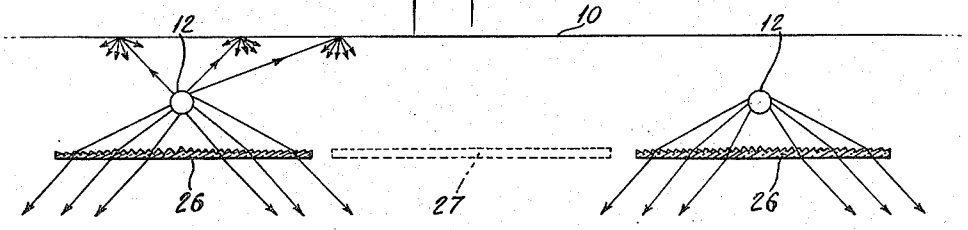


Fig. 9.



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UNITED STATES PATENT OFFICE

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DOWN LIGHTING APPARATUS

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Application February 5, 1944, Serial No. 521,167

8 Claims. (Cl. 240—9)

The present invention relates to down lighting apparatus, and is more particularly directed toward such apparatus which forms the entire surfacing of a ceiling area.

Recessed fluorescent lighting has heretofore been used in ceilings of various types and when so used the light comes from reflectors, lenses, or diffusers occupying only a portion of the ceiling area. In such constructions the ceiling area between the lighting equipment is lighted only by reflected light returned from the floor, walls and objects in the room, and hence the brightness contrasts are very high. Owing to the losses in the reflectors used to get the light out of the luminaries referred to and the interception of light by other lamps in the same unit, the utilization factor is comparatively low.

The present invention contemplates down lighting apparatus wherein the entire overhead surface area is in the form of light transmitting plates and all these plates are rendered luminous so that the entire ceiling is lighted up with comparatively small differences in brightness at the ordinary angles of observation.

A further object of the present invention is to eliminate much of the expense of lamp boxes, wireways and false ceiling supports customarily employed, and to reduce the mechanical features of the installation to their simplest terms, for example, lamps, lamp sockets or holders supported from the original ceiling or from the lens supports, lens plates and "filler" plates, channels or T-bars suspended from the original ceiling and supporting the plates, lamp auxiliaries supported in any convenient way between the two ceilings and serving lamps in pairs or fours as desired, and wiring in BX or wire mold or similar simple construction. No box or enclosure of sheet metal or other material is required. All parts between the two ceilings would ordinarily be painted white in so far as practical.

The accompanying drawings show, for purposes of illustrating the present invention, several embodiments in which the invention may take form, it being understood that the drawings are illustrative of the invention rather than limiting the same.

In these drawings:

Figure 1 is a cross section and semi-perspective view showing the general arrangement of the down lighting apparatus;

Figures 2A, 2B and 2C are diagrammatic inverted plan views of a ceiling equipped with the down lighting apparatus;

Figure 3 is a cross sectional view showing an optical action of one form of construction and omitting structural features;

Figure 4 is a detailed sectional view through typical prisms of a filler plate; and

Figures 5 to 9, inclusive, are views similar to Figure 3 showing modified forms of construction.

In Figure 1 the superstructure 10 may be the original ceiling, or the bottom of the floor slab. At suitably spaced intervals the superstructure, or ceiling, carries longitudinally extending supports 11. Rectilinear lamps 12 are suitably mounted below the ceiling 10 and are preferably placed halfway between certain of the supports 11.

The supports 11, which are closest to the lamps 12, support prismatic lens plates 13, 13 of a light concentrating type in rows corresponding with the length of the lamp or lamps employed. The spaces between the rows of lens plates 13, 13 are occupied by filler plates 14, 14. The lens plates and filler plates may be any size convenient for handling.

The dominant feature resides in the use of lens plates and intermediate filler plates. The lamps, lenses and plates may be placed in parallel rows extending lengthwise of the ceiling area as in Figure 2A, or the ceiling plan arrangement may be varied to suit, as, for example, shown in Figures 2B and 2C. The lamps and rows of lenses and plates may extend diagonally of the ceiling space, if desired.

In Figure 3 an arrangement is shown according to which the lamps 12 are above prismatic lens plates 13 which partially concentrate the direct light falling on them, and the plates 13, 13 are between filler plates 14 which have reflecting prisms 15 on the upper surface, although they may be mere diffusing plates, if desired. The ceiling 10 has a diffuse reflecting surface, for example, white paint. The lens plates are preferably made of the maximum width by which light can be concentrated to the desired extent by dioptric prisms. For regularity of appearance and flexibility of mounting the widths of plates 13 and 14 are preferably the same. The plates 14 accept direct rays, such as indicated at 16, 16, Figure 4, from the lamps 12, 12 and reflect these rays downwardly as indicated at 17, 17, and, if desired, these rays may be caused to slightly diverge by providing the bottom of the plates with diffusing flutes 18.

In the arrangement shown in Figures 3 and 4 direct light through a very wide angle each side of the nadir is accepted by the plates and transmitted into the desired directions. The upwardly

emitted light is intercepted by the ceiling and diffusely reflected downwardly where it adds to the general downwardly directed illumination. In this arrangement the plates are shown flat and a flat ceiling is illustrated, but it is, of course, possible to use flat plates opposite domed or curved ceilings. As the lamps are very remote from one another no loss is brought about by having one lamp obstruct the light from another, as is common in fluorescent lighting equipment employing two or more comparatively closely placed lamps. Furthermore it is possible to make the equipment very shallow, for example, the lens plates one foot wide need be only 4 inches or 5 inches below the reflecting surface of the ceiling.

The prisms 15 preferably have an apex angle of approximately 60° and the prism surfaces may be plane or curved. These prisms will receive light from the lamps between angles of 60° and 90° from the nadir and reflect such light downwardly with high efficiency.

In the arrangement shown in Figure 5 the prismatic lens plate 13 is the same as before, but two filler plates 20, 20' are used and each slopes upwardly from the adjacent edge of the light concentrating plates 13 so that all the light emitted below the horizontal is intercepted by plates 13 and 20 or 20'. Plate 20 is shown as having refracting prisms 21 which lower the light as indicated, while the plate 20' is shown with reflecting prisms for the same purpose. The ceiling 10 diffusely reflects the light as before.

In the arrangements shown in Figures 6 to 8, inclusive, the light concentrating plates 22 are dished so as to intercept more of the light emitted by the lamps below the horizontal than the flat plates 13. The filler plate 23 of Figure 6 receives no direct light, but does receive light diffusely reflected down by the ceiling 10, and this plate may therefore be a simple diffusing plate. The plates 24 and 25 of Figures 7 and 8 receive light reflected toward them by the specular reflectors 26 and 27, respectively, and the plates 24 and 25 are therefore preferably reflecting plates of the type indicated in Figure 4.

In the arrangement shown in Figure 9 the lens plates 26 under the lamps are of the light spreading type and they may be used with filler plates 27 of any of the forms above discussed. Such lens plates will provide a more extensive distribution of light.

It will be noted that the down lighting apparatus shown herein is one wherein the lighting equipment typically occupies a large portion of the ceiling area and may be rendered luminous when in operation. It therefore has much less brightness contrast than ceiling constructions wherein part of the ceiling is illuminated only by reflected light. It also has less maximum brightness than ceiling constructions using the same size and amount of lighting equipment, but having reflectors which send the light downwardly and therefore build up the amount of light which must be transmitted through the narrowed region.

The equipment is one which has a high efficiency of light utilization and it is readily possible to obtain varied intensities of illumination by varying the number of rows of filler plates used for each row of lens plates. If, for example, the rows of lens plates and filler plates be alternated and a certain average horizontal illumination be obtained, then it is possible to obtain two-thirds of this illumination by using two rows of filler plates between each row of lens plates; or it is possible to obtain one-half the original illumination by using three rows of filler plates between each row of lens plates. In locations where extremely high illumination intensities are desired, the entire area may be covered with lens plates with one or more lamps over each plate.

In practicing the present invention it is possible to use plates which are flat or dished, horizontal, or sloping and provided with refracting prisms near the lamps and with reflecting or refracting prisms more remote from the lamps, or in the latter location, diffusing plates may be used. The arrangement of light controlling prisms is designed for optical control of the light rays, while the size of the plates on which the prisms (or diffusing surfaces where used) are disposed is determined by convenience in manufacturing methods and installations. The reflecting surface above the lamps may be specular, semi-specular or diffuse and of suitable contour.

Since it is obvious that the invention may be embodied in other forms and constructions within the scope of the claims, I wish it to be understood that the particular forms shown are but a few of these forms, and various modifications and changes being possible, I do not otherwise limit myself in any way with respect thereto.

What is claimed is:

1. Down lighting apparatus comprising a downwardly reflecting surface of extended area, elongated parallel rectilinear lamps distributed below the extended area of the reflecting surface and mounted adjacent thereto, refracting plates below the lamps, the plates each having longitudinally extending dioptric prisms of variant refracting power disposed each side of a vertical plane through the superposed lamp, the angle subtended by the plates being such as to accept substantially all the downwardly emitted direct light which can be effectively transmitted by such prisms when embodied in a plate, the plates acting to symmetrically alter the spread of light from the corresponding superposed lamps and direct the transmitted rays into beams with controlled spread toward regions of a working area underneath and to each side of said corresponding lamps, the lamps being laterally spaced from one another to leave spaces between adjacent edges of the prismatic plates of substantial width, and light redirecting filler plates occupying the said spaces and being disposed between the refracting plates, the filler plates receiving light originating in the adjacent lamps and emitted at angles above the edges of the refracting plates and reflected downwardly from said reflecting surface and transmitting such light in generally downward directions whereby substantially all the light emitted by the lamps is received by the plates either as direct light or as once reflected light, and all the plates appear luminous, the filler plates acting to build up the light flux received in said working area, beneath the filler plates.

2. Apparatus as claimed in claim 1, wherein all the plates are flat and at a common level with the refracting plates so that the filler plates receive direct light.

3. Apparatus as claimed in claim 1, wherein all the plates are flat and at a common level with the refracting plates so that the filler plates receive direct light and the filler plates are provided with light directing ribs parallel with the sources and disposed to accept direct light and bend it downwardly.

4. Apparatus as claimed in claim 1, wherein the filler plates are flat and at a common level

with the refracting plates so that the filler plates receive direct light and are provided on their upper surfaces with light reflecting ribs parallel to the sources which reflect light generally downwardly.

5. Apparatus as claimed in claim 1, wherein the filler plates are flat and at a common level with the refracting plates so that the filler plates receive direct light and are provided on their upper surfaces with light reflecting ribs parallel to the adjacent sources which reflect light generally downwardly, and diffusing flutes on the lower surface which scatter light laterally.

6. Apparatus as claimed in claim 1, wherein two filler plates are employed between adjacent refracting plates and they extend upwardly from the edges of the refracting plates to substantially the level of the lamps so as to receive light emitted between the horizontal and the refracting plates and have light depressing prisms.

7. Apparatus as claimed in claim 1, wherein the light refracting plates are dished to accept substantially all direct light below the horizontal and the filler plates are substantially at the level of the sources.

8. Apparatus as claimed in claim 1, wherein the reflecting surface includes specular reflectors disposed to reflect light on to the filler plates, and wherein the refracting plates are dished to accept substantially all direct light below the horizontal and the filler plates are substantially at the level of the sources and the filler plates are provided with ribs parallel with the sources which reflect light downwardly.

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