United States Patent [19]

Edman et al.

[11] **3,766,375**

[45] **Oct. 16, 1973**

[54] **INTERCHANGE AND AREA LIGHTING LUMINAIRE**

[75] Inventors: **Warren H. Edman**, Hohokus, N.J.; **James W. Patyrak**, Newark, Ohio

[73] Assignee: **Holophane Company, Inc.**, New York, N.Y.

[22] Filed: **Nov. 29, 1971**

[21] Appl. No.: **203,020**

Related U.S. Application Data

[63] Continuation of Ser. No. 829,475, June 2, 1969, abandoned, which is a continuation-in-part of Ser. No. 734,841, June 3, 1968, abandoned.

[52] **U.S. Cl.** ..... **240/25,** 240/93, 240/160 R

[51] **Int. Cl.** **F21s 1/10**

[58] **Field of Search** ..... 240/25, 106, 41.35 R, 240/41.3, 93

[56] **References Cited**

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Primary Examiner—Samuel S. Matthews
Assistant Examiner—Richard M. Sheer
Attorney—Robert M. Krone

[57] **ABSTRACT**

The combination of reflector, skirted with a refractor for redistributing some of the reflected and some of the direct light from a light source disposed at very high mounting heights, provides a luminaire to light interchange and other highway areas, eliminating the need for positioning highway lighting luminaires adjacent the highway.

15 Claims, 17 Drawing Figures

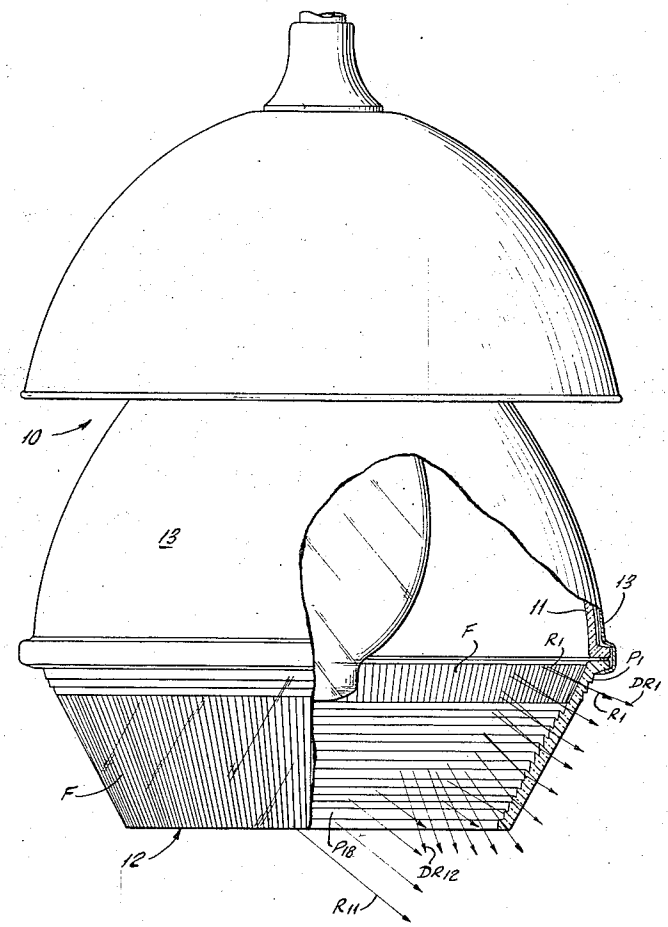
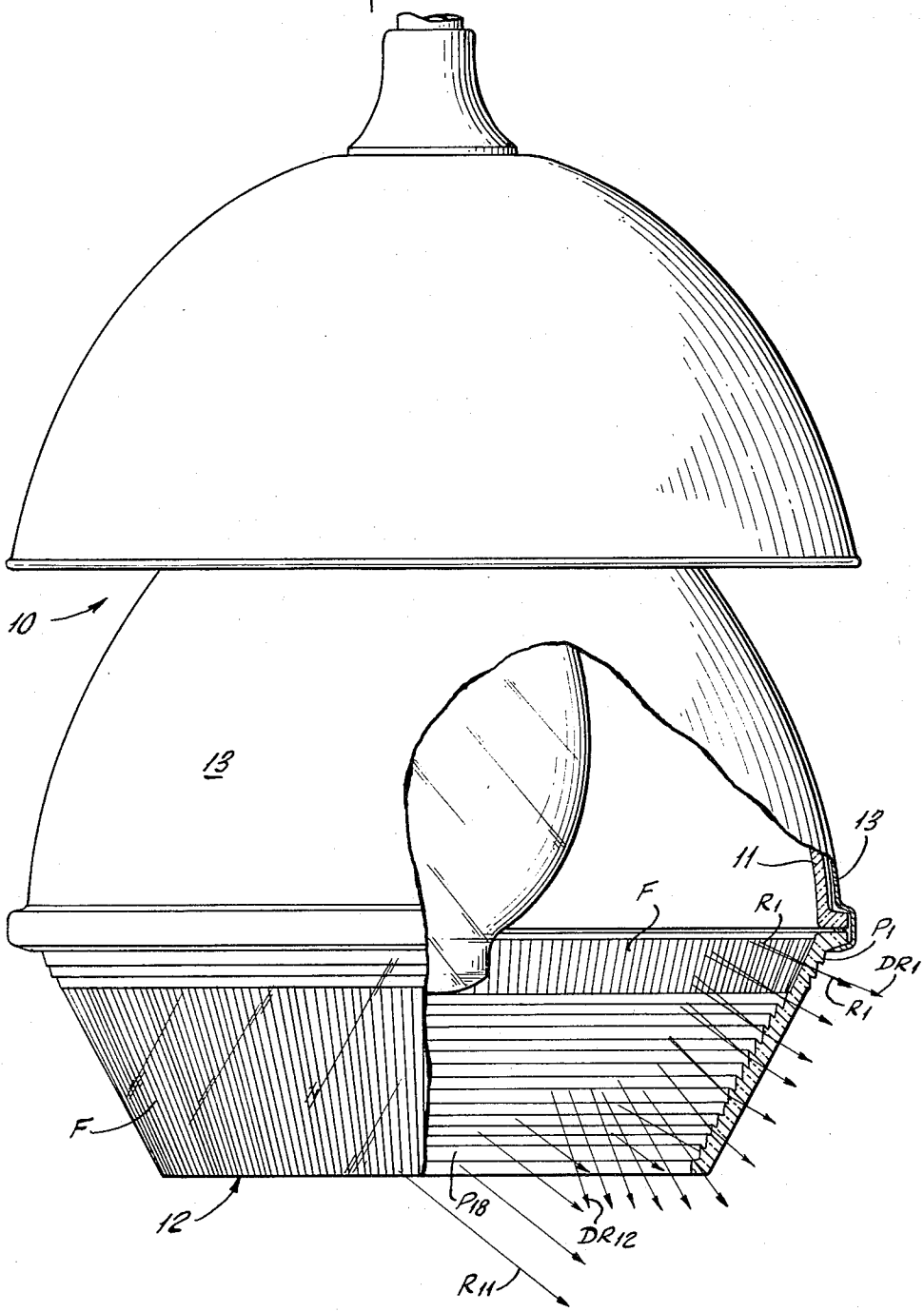


Fig. 1



INVENTORS
WARREN H. EDMAN
JAMES W. PATYRAK
BY
Nolte & Nolte
ATTORNEYS

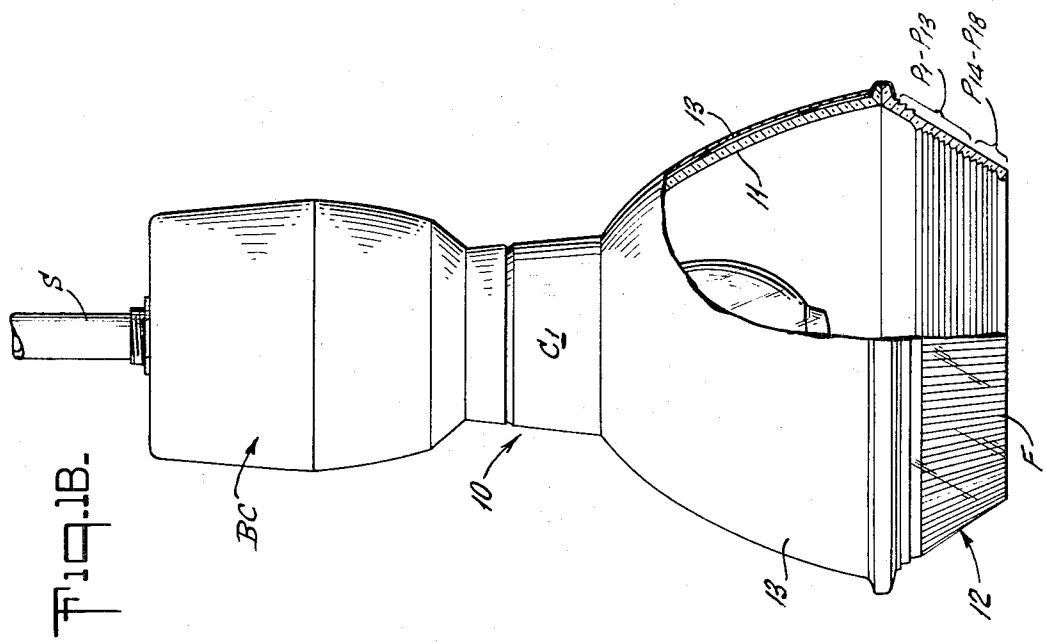


FIG. 1B.

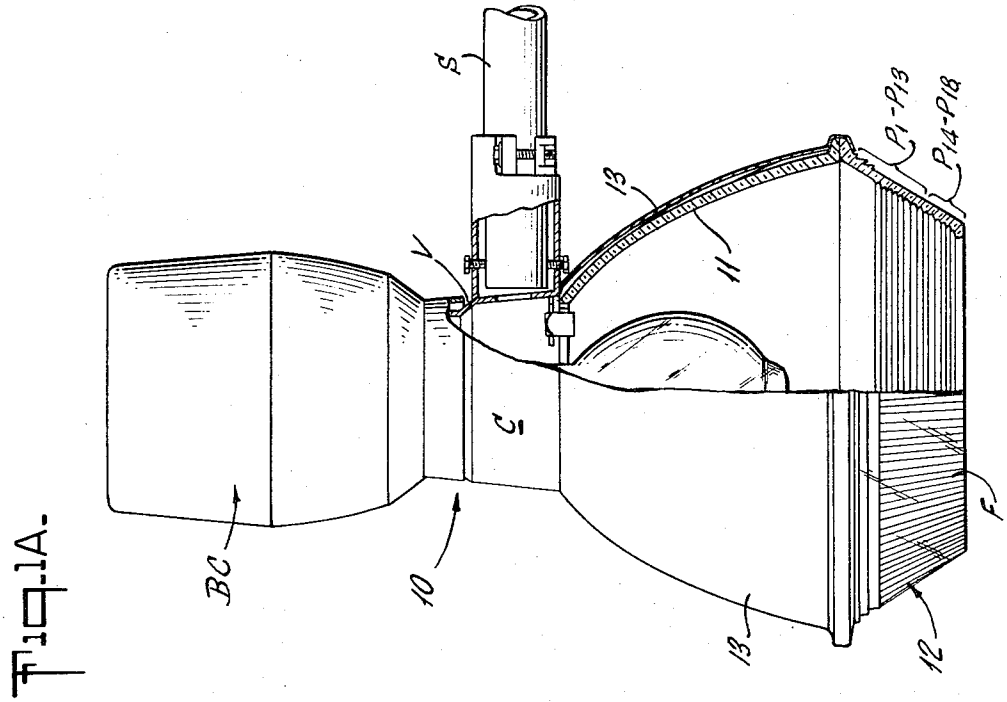


FIG. 1A.

INVENTORS
WARREN H. EDMAN
JAMES W. PATYRAK
BY
Nolte & Nolte
ATTORNEYS

FIG. 2.

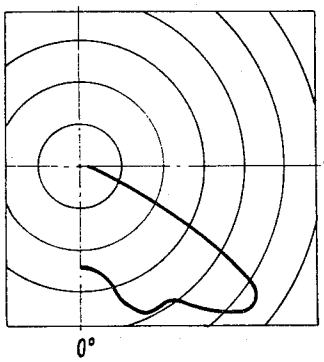


FIG. 2A.

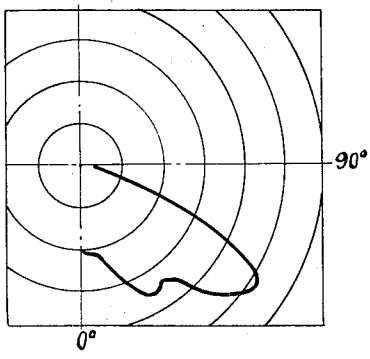


FIG. 2B.

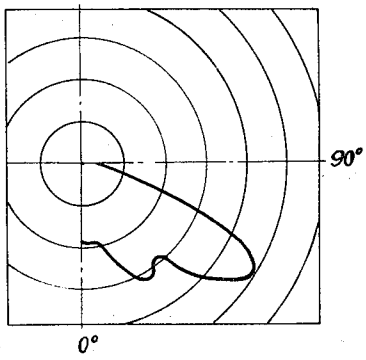
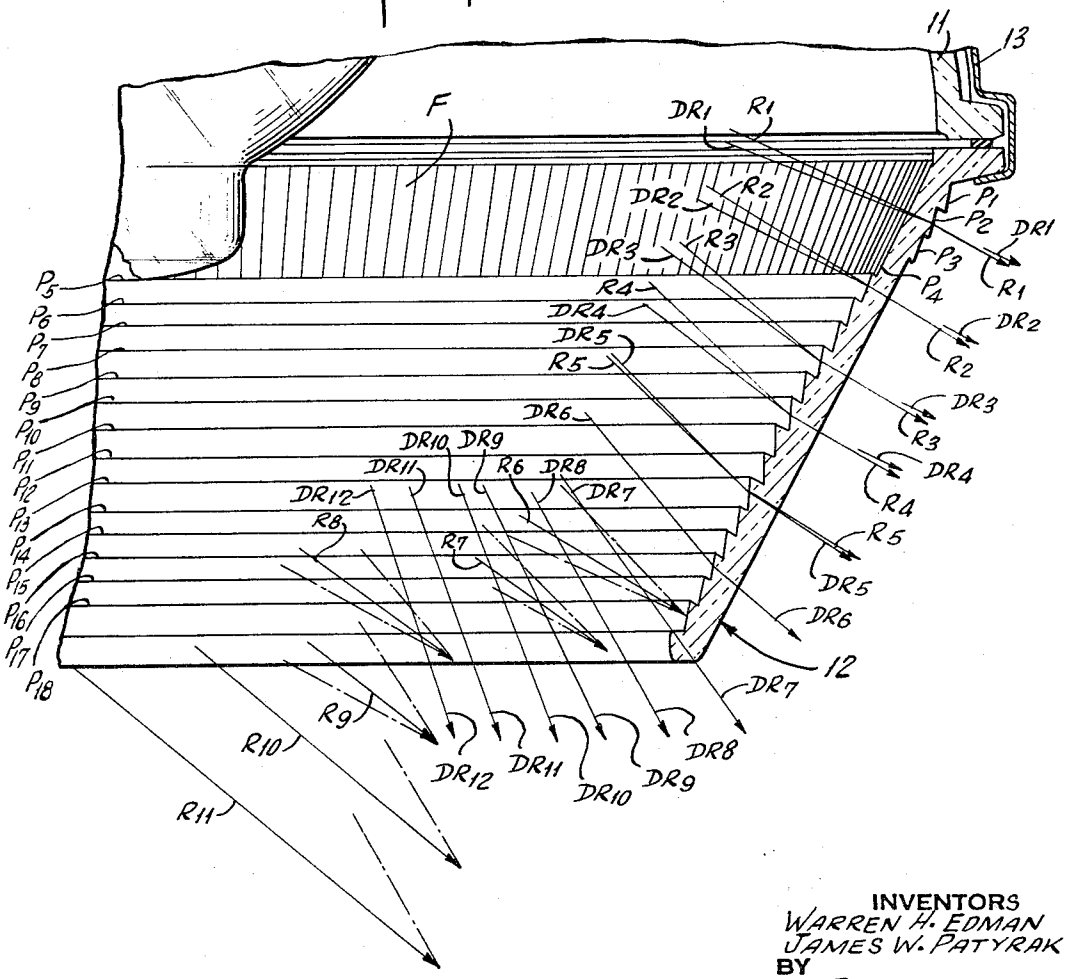


FIG. 3.



INVENTORS
WARREN H. EDMAN
JAMES W. PATYRAK
BY
Nolte & Nolte
ATTORNEYS

Fig. 4.

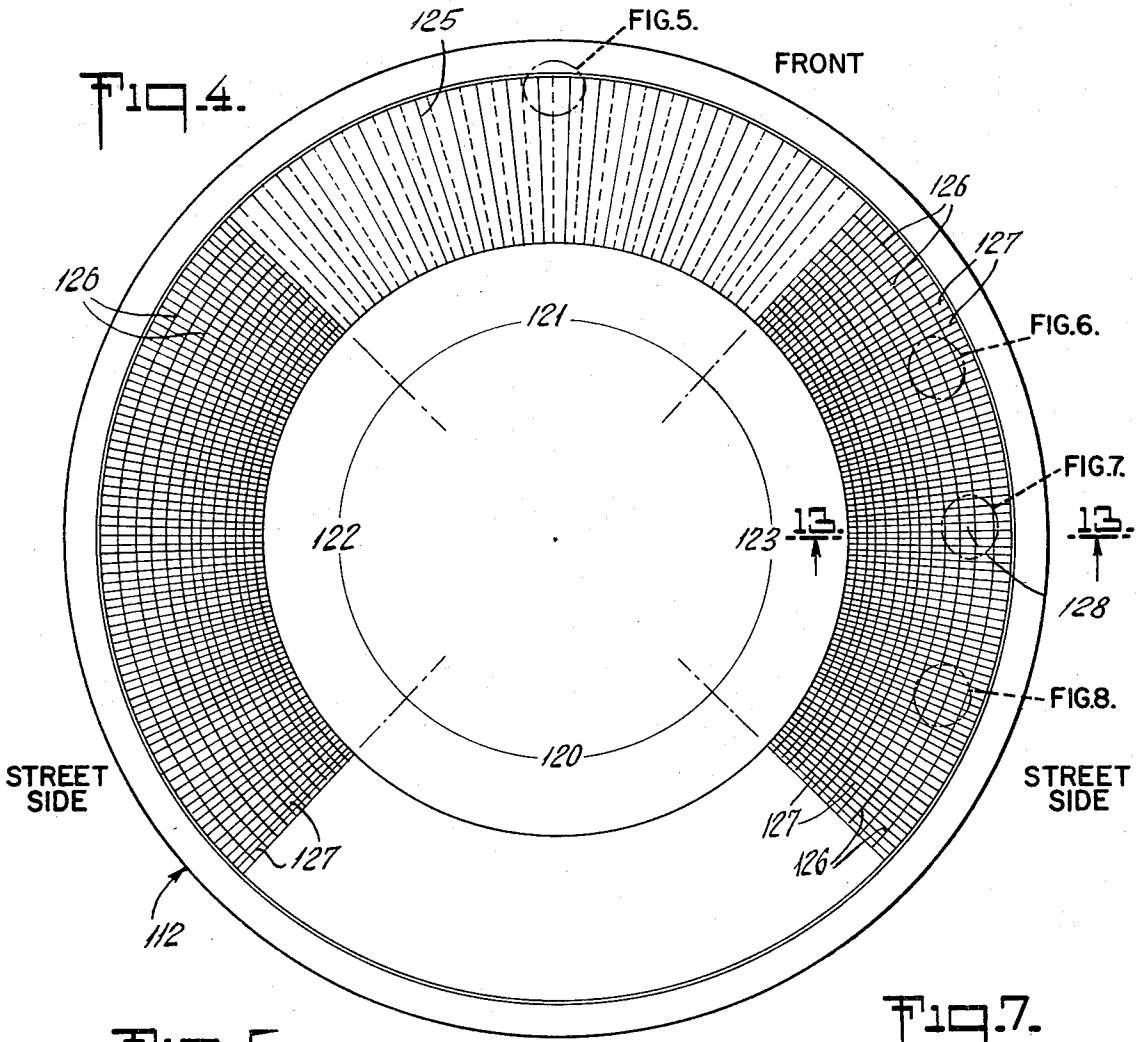
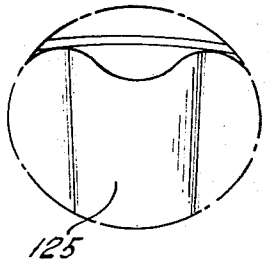


Fig. 5.



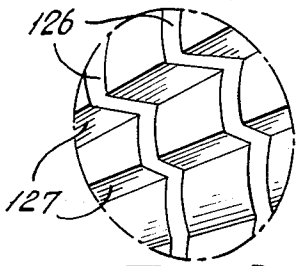
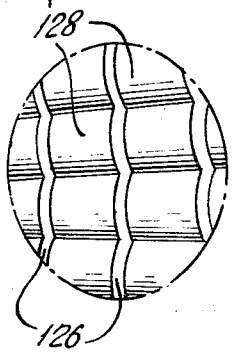


Fig. 6.

Fig. 7.



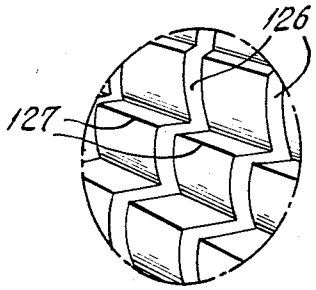


Fig. 8.

INVENTORS
WARREN H. EDMAN
JAMES W. PATYRAK
BY
Nolte & Nolte
ATTORNEYS

Fig. 9.

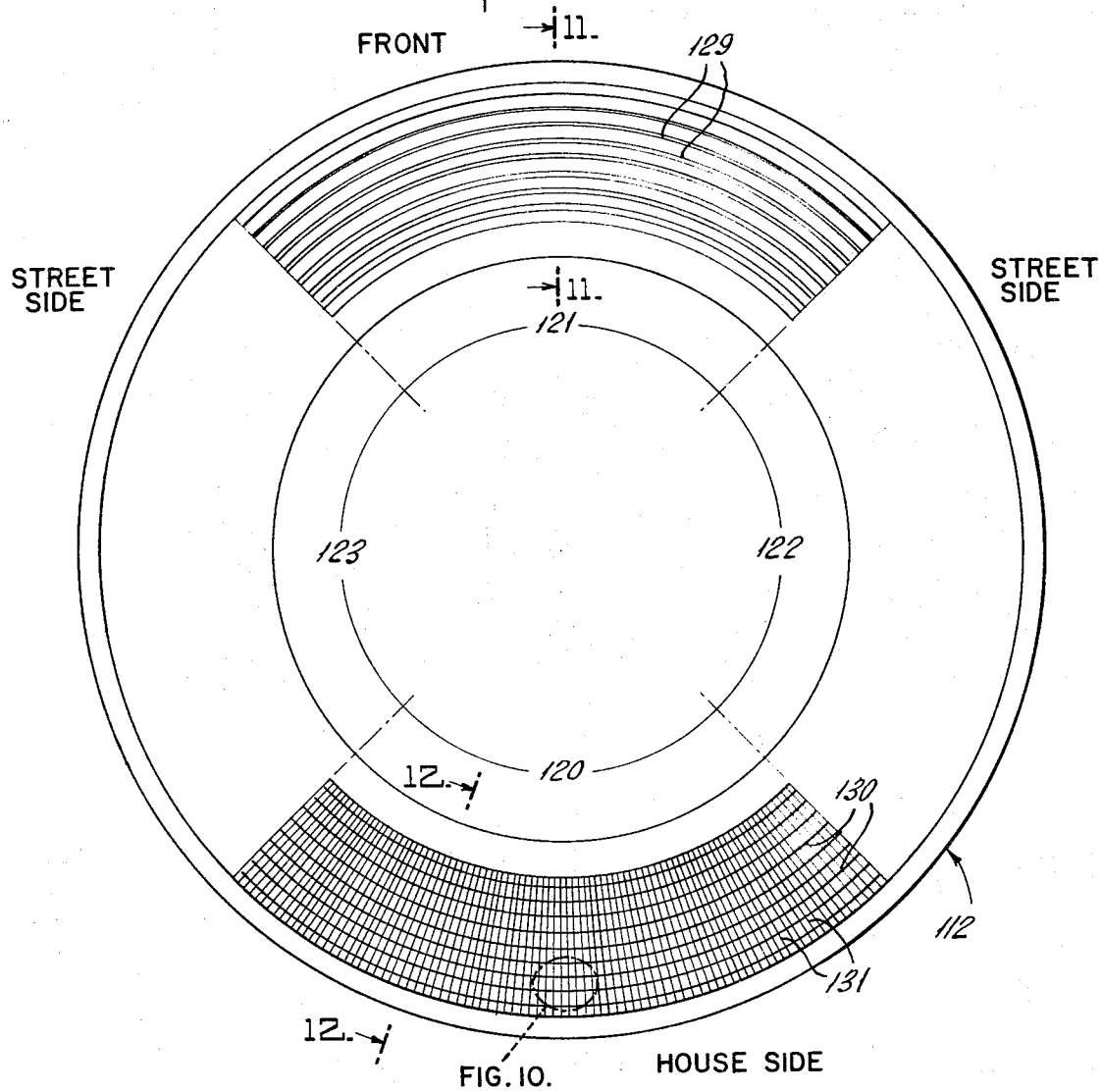


FIG. 10.

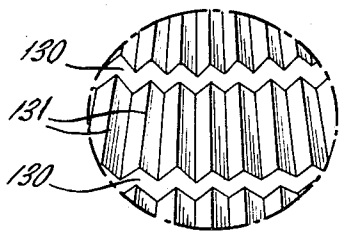


Fig. 10.

INVENTORS
WARREN H. EDMAN
JAMES W. PATYRAK
BY
Nolte & Nolte
ATTORNEYS

Fig. 11.

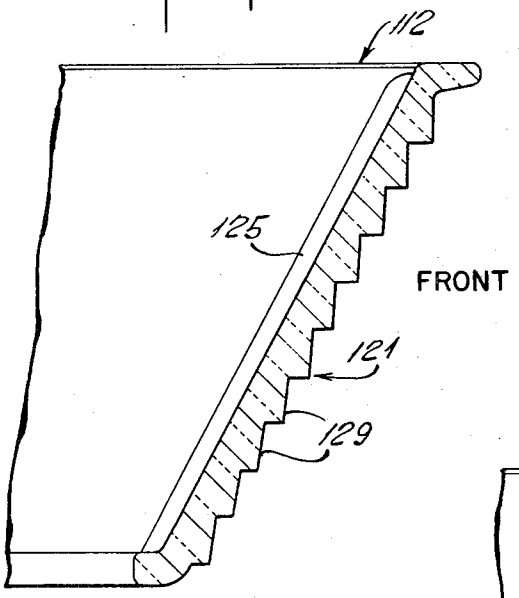


Fig. 12.

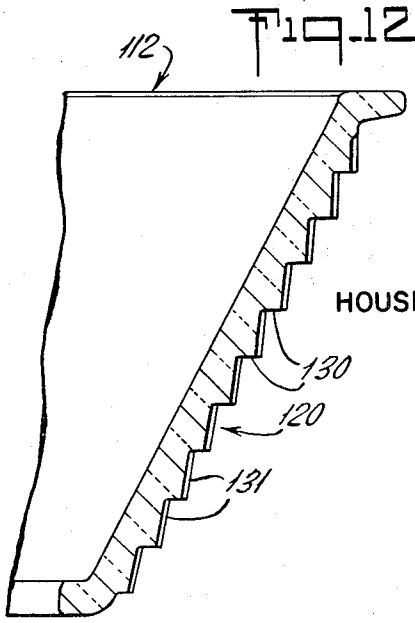
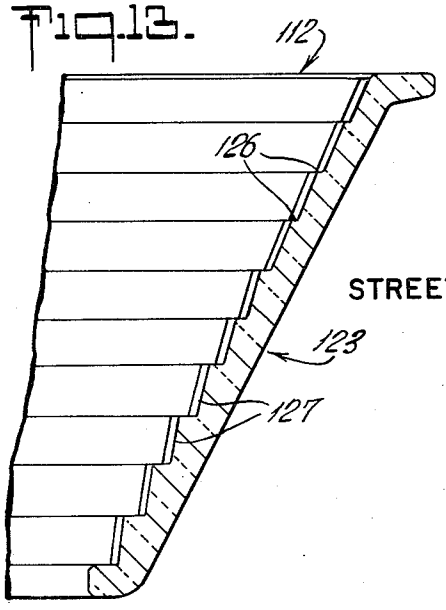


Fig. 13.



INVENTORS
WARREN H. EDMAN
JAMES W. PATYRAK
BY
Nolte & Nolte
ATTORNEYS

INTERCHANGE AND AREA LIGHTING LUMINAIRE

This application is a continuation of application Ser. No. 829,475, filed June 2, 1969, now abandoned, which in turn is a continuation-in-part of application Ser. No. 734,841, filed June 3, 1968, now abandoned.

Present practice in street lighting is to illuminate the roadway with little attention to the area around the roadway both from the aesthetic point and the safety and comfort point of the driver, it would be desirable to illuminate not only the roadway but the area surrounding it. On today's modern highways, one conceivable area would be the interchange. To do this one would use 100 foot high mounted type V luminaires. As the driver approaches the interchange, instead of seeing a cluttering of 30 foot luminaires only lighting the roadway, he would approach an uncluttered area which is uniformly lighted.

Another conceivable area would be the border area of multilaned highways and to do this one would use 40 to 100 foot high mounted type II luminaires.

There is much possibility that the uniform illumination of the entire areas would make the driver unconscious of the units; i.e., simulate daylight. Aesthetically, the units would beautify the area during the night as well as during the day. From the comfort and safety standpoint, there are important advantages. Using fewer units, there would be fewer poles and less likelihood of a driver hitting one. Also, in interchange lighting, the poles could be as much as 150 – 200 feet from the roadway, again reducing the possibility of a driver hitting the pole.

Due to the high mounting height, necessarily, the beams are lower, eliminating glare from the luminaire and since the light is at lower angles, the specular component of reflected light off of the roadway is greatly reduced, increasing the driver's comfort and safety.

As one can readily see, the luminaire would be quite pleasing both aesthetically and from the standpoint of safety and comfort to the driver.

FIG. 1 is a side elevational, partly sectional view of an interchange luminaire of the invention;

FIG. 1A is a side elevational, partly sectional view of an interchange luminaire of the invention and adapted for side mounting;

FIG. 1B is a side elevational, partly sectional view of an interchange luminaire of the invention and adapted for top mounting;

FIG. 2 is a vertical light distribution curve produced by such a luminaire with the light center in design position;

FIG. 2A is a vertical light distribution curve produced by such a luminaire with the light center disposed below design position (⅜ inch);

FIG. 2B is a vertical light distribution curve produced by such a luminaire with the light center disposed even further below design position (¾ inch);

FIG. 3 is the bottom portion of FIG. 1, enlarged and has been added to show the ray traces and their angular values;

FIG. 4 is a top view of the bottom skirt portion of a luminaire of the present invention which is to be positioned at the side of a roadway;

FIG. 5 is a magnified view of a portion of the bottom skirt portion of FIG. 4;

FIG. 6 is a magnified view of a second portion of the bottom skirt portion of FIG. 4;

FIG. 7 is a magnified view of a third portion of the bottom skirt portion of FIG. 4;

FIG. 8 is a magnified view of a fourth portion of the bottom skirt portion of FIG. 4;

FIG. 9 is a bottom view of the bottom skirt portion of FIG. 4;

FIG. 10 is a magnified view of a portion of the skirt portion of FIG. 9;

FIG. 11 is a cross-sectional view of the bottom skirt taken along axis 11 — 11 of FIG. 9;

FIG. 12 is a cross-sectional view of the bottom skirt taken along axis 12 — 12 of FIG. 9; and

FIG. 13 is a cross-sectional view of the bottom skirt taken along axis 13 — 13 of FIG. 4.

The units **10** for interchange illumination are designed to give a beam of 53° vertical to work at the previously mentioned 100 foot mounting height. By changing light center, the beam can be adjusted to 55° or 58°, but possibly sacrificing uniformity. By mounting three units on one pole, one can maintain 1.5 average ft. — candles with a minimum-to-average ratio of about 3.6 : 1 at a spacing of 4 : 1 with the light center set at the 58° position.

Referring to FIGS. **1** and/or **2**, physically, the interchange units consist of a reflector **11** and an open bottom skirt **12.** The two pieces of glass are spun together with an aluminum cover **13.** The luminaire **10** including a ballast chamber BC is mounted via supports S. A bracket arm casting C (FIG. 1A) or a hood casting C_1 (FIG. 1B) connects the ballast and the reflector. A rain shield, designated as such, covers the upper portion of the casting C, C_1 which is provided with vent holes, as designated in the drawings. Being open at the bottom and vented at the top, there is a "chimney effect" which will tend to prevent large amounts of dirt from accumulating in the optical assembly. Using a 1000 Watt metal halide lamp the following optical criteria were used in the design of the unit.

Basically, the glass prismatic reflector **11** produces a beam of approximately 45° – 50° from the vertical.

When the glass refractor **1** as shown, or a similarly prismatic plastic refractor, is used in conjunction with the reflector, one is able to obtain the desired distribution. The refractor prisms P1 – P13 take advantage of the fact that the reflected and direct light ($R_1 - R_{11}$ are the reflected light rays; $DR_1 - DR_{12}$ are the direct light rays; see FIG. 3) lie at approximately the same angles. Due to this fact both elements, the direct and reflected light, can be controlled with the same prism. Prisms P1 – P3 on the exterior serve to depress both the reflected rays and the direct rays while prisms P4 – P13 serve to elevate the reflected and direct rays. Beginning with prism P13 and continuing, a separation of the direct and reflector light is apparent. The reflected light maintains a beam of approximately 50° while the direct light tends toward lower angles. Because of this fact, a single prism can no longer control both the light rays and a bending of the light which has been elevated by prisms P4 – P13 is accomplished by prisms P14 – P18 with the direct light and reflector light which is not refracted (i.e., that which does not intercept the skirt).

The flutes F in the interior and exterior of the refractor serve to spread the light 15° in a plane normal to the extension of the flute. This serves to enhance the appearance of the unit and eliminate any sharp undesirable characteristics which may be inherent in the lamp. Instead of continuous flutes F, internal flutes may be

superimposed upon the horizontal prisms P, such a construction being shown in FIG. 7 with reference to another embodiment of the invention, to be discussed.

The intermediates on the elevating prisms on the refractor were made so as to eliminate as much interception of light as possible while also keeping in mind the smallest included angle allowable for pressing the glass easily.

Photometrically, the unit performs exceedingly well. A 60° beam was the design point, however, due to the wide spreading of the reflector light the beam appears to be around 53° in the standard or design position. See FIG. 2. By moving the light center the beam can be raised to 55°, see FIG. 2A, or 58°, see FIG. 2B. Naturally the design position will provide the greatest uniformity. The unit **10**, from an aesthetic and driver comfort and safety standpoints, has tested our well. Providing a plurality of positions for the unit will allow a larger mounting height to spacing ratio by sacrificing a little in uniformity. As an area unit or interchange luminaire it has many notable characteristics.

In the second preferred embodiment, illustrated in FIGS. **4 – 13**, the illumination of a highway and its bordering area is achieved by mounting a type II luminaire at a height of over the standard **30**; preferably within a range from 40 to 100 feet.

Physically these units have the same structure as the interchange unit **10**. Consequently the reflected light ($R_1 - R_{11}$ of FIG. 3) at about 45°–50° vertical and the direct light ($DR_1 - DR_{12}$, FIG. 3) striking the bottom skirt **112** will also lie at approximately the same angles and therefore can be similarly controlled by the same refractor skirt prism.

These border luminaire bottom refracting skirts **112** are divided into four 90° sections: a house side section **120** which will be on the back portion of the luminaire bottom refractor skirt **112**, an opposite street side section **121**, and two side sections **122, 123** which will face up and down the street.

The side sections **122, 123** have interior horizontally extending prisms **126** for vertically lifting light incident thereon to the 53°, 55°, 58° range according to the placement of the light center, and as opposed to standard luminaire beams which are between 60°–72° vertical. Superimposed on top of these large horizontal prisms are small vertically extending refracting prisms **127** covering a considerable area coming in from either end of the side sections for turning the incident light laterally into the street or roadway area to be lighted. As in standard luminaires, lateral deviation is kept within about 42°.

These prisms **127** have curved active surfaces for simultaneously diffusing the incident light as it is being laterally redirected. The curvature of these prisms varies along the side of the refractor from deepest toward the center plane through the light source to more shallow, then straight at the ends of the side sections where diffusion is unnecessary for uniform viewing luminosity.

Similarly the depth of the prisms **127** varies for greater refractor power at the ends to lessen refractive powers toward the center.

Each street side sector **122, 123** has a neutral zone (FIG. 7) wherein incident light will be vertically controlled by the horizontal prisms **126** but which will be emitted in an undeviated lateral direction. Vertically extending shallow flutes **128** superimposed on prisms **126** will diffuse the incident light. Flutes **128** cover a relatively narrow control area, about five or six flutes wide.

Depending upon the design of the bottom refractor skirt **112** the horizontally extending prisms **126** may not extend upwardly to the top of the skirt **112** so that the top three or so prisms may be non-existent. In such a situation external depressing prisms may be utilized to achieve the desired vertical control (P1 – P3 of FIG. 3).

The exterior side surfaces **122, 123** of the bottom refractor skirt **112** will normally be smooth (FIG. 9) but if desired shallow flutes vertically extending from the top to the bottom of the street sides of the skirt may be utilized to achieve greater diffusion.

The street side sector **121** has fairly deep undulating fluting **125** on the interior thereof (FIG. 5) for diffusing light incident thereon and external horizontally extending prisms **129** (FIG. 11) for vertically depressing incident light.

The house side sector **120** has a plurality of rows of external substantially horizontal refracting prisms **130** on top of which are superimposed a plurality of substantially vertically extending reflecting prisms **131** (FIG. 12). If additional house side elevation is required horizontally extending elevating prisms can be placed on the interior surface of the skirt **112** in that area for lighting adjacent curb side structure.

What is claimed is:

1. A street lighting luminaire comprising a reflector, a prismatic refractor, a high wattage light source within said reflector, said light source and reflector being disposed so as to constitute means for emitting and reflecting light, respectively, at approximately the same first relatively low vertical angles in the aarea of the refractor, said refractor having a central aperture and including prisms along a lower portion of the inner surface thereof, said prisms having active surfaces disposed so as to constitute means for lifting light reflected by the reflector and light emitted directly from the source to approximately the same second relatively low vertical angles, the aperture of the refractor comprising means for passing light emitted directly from the light source and light reflected from the reflector and not incident upon the refractor, therethrough and vertical flutes on said refractor for relatively wide lateral diffusion of the light passing through the refractor.

2. The luminaire of claim **1**, wherein said first relatively low vertical angles range between 45° – 50° and said second relatively low vertical angles range between 53° and 58°.

3. The luminaire of claim **1** wherein said reflector is a prismatic reflector, said reflector and refractor have opposing annular faces spun together, an aluminum cover covers said prismatic reflector, said reflector, refractor and cover being apertured along a vertical axis.

4. The luminaire of claim **1** constituting means for lighting interchange and other large areas and wherein said prisms along the inner surface are annular and further constitute means for refracting light incident thereon into a circular beam at approximately 53° vertical.

5. The luminaire of claim **3** constituting means for lighting interchange and other large areas and wherein said vertical flutes are arranged on a lower portion of the outside surface of said refractor for relatively wide lateral diffusion of the refracted light, and an upper

portion of said refractor has annular prisms on the outer surface thereof and vertical flutes on an upper portion of the inside surface thereof for lateral diffusion of light incident thereon, said annular prisms on the outer surface comprising means for depressing reflected and direct light.

6. The luminaire of claim **2** constituting means for type II light distribution upon a street, highway and the like, wherein said refractor comprises a front, rear and two side portions, said two side portions including said prisms along the internal surface thereon and said vertical flutes are disposed on the outer surface thereof and also internally in the central areas of said side portions, said two side portions also including vertically oriented prism means superimposed on said prisms along the internal surface of said refractor for laterally, deviating light incident thereon toward a vertical plane passing through the light source and the central areas of said side sections.

7. The luminaire of claim **6** wherein said vertically oriented prism means are convex along their active surfaces the curvature thereof decreasingly varying from the central areas of said side section toward the rear and front ends.

8. The luminaire of claim **6** wherein said vertically oriented prisms decreasingly vary in refractive power from the central areas of said side section toward the rear and front ends.

9. The luminaire of claim **6** wherein said front portion includes means on the external surface thereof for depressing light from said source.

10. The luminaire of claim **6** wherein said rear section includes means on the external surface thereof for reflecting light from said source and said reflector.

11. The luminaire of claim **8,** the internal surface of said front section includes flutes apposing said light depressing means.

12. The luminaire of claim **10** constituting means for distributing reflected and direct light into a circular beam at approximately 53° vertical at a mounting height between 40 feet and 100 feet.

13. A luminaire for interchange and area lighting comprising a prismatic reflector, a prismatic refractor, said reflector and refractor having opposite annular faces spun together, an aluminum cover covering said prismatic reflector, said reflector, refractor and cover being apertured along a vertical axis, a high wattage light source within said reflector, said light source and reflector being disposed so as to constitute means for emitting and reflecting light, respectively, at approximately the same angles in the area of said refractor, said refractor including annular prisms along a lower portion of the inner surface thereof and having their active surfaces disposed so as to constitute means for lifting reflected and direct light striking the same at approximately the same angle, the aperture of said refractor comprising means for passing unchanged reflected and direct light, vertical flutes arranged on a lower portion of the outside surface of said refractor for relatively wide lateral diffusion of the refracted light, an upper portion of said refractor having annular prisms on the outer surface thereof and vertical flutes on the inside surface thereof, said annular prisms on the outer surface comprising means for depressing reflected and direct light and the vertical flutes on the inside surface thereof comprising means for laterally diffusing light incident thereon.

14. The luminaire of claim **13,** constituting means for distributing reflected and direct light into a Type II distribution with the lateral beams at approximately 53° vertical at a mounting height between 40 feet and 100 feet.

15. A street luminaire comprising a prismatic reflector, a prismatic refractor having front, rear and opposed side portions, said reflector and refractor having opposing annular faces spun together, an aluminum cover covering said prismatic reflector, said reflector, refractor and cover being apertured along a vertical axis, a high wattage light source within said reflector, said light source and reflector being disposed so as to constitute means for emitting and reflecting light, respectively, at approximately the same angels in the area of said refractor, said refractor including annular prisms along the inner surface on opposed side portions thereof, each prism having an active surface, vertical prisms of varying refractive power, superimposed on the active surfaces of said annular prisms and including convex surfaces of varying curvature, said annular prisms having their active surfaces disposed so as to constitute means for lifting reflected and direct light striking the same at approximately the same angle, reflecting means and light depressing means on, respectively, the rear and front portions of said refractor, the aperture of said refractor comprising means for passing unchanged reflected and direct light, said front portion of said refractor having annular prisms on the outer surface thereof, said annular prisms on the outer surface comprising means for depressing reflected and direct light.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,766,375 Dated October 16, 1973

Inventor(s) Warren H. Edman and James W. Patyrak

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 34, "the same" should read --equal--; line 35, delete "a" before "area"; line 39, insert --said-- between "lifting" and "light"; line 40, insert --said-- between "and" and "light"; line 42, insert --said second angles being greater than said first angles-- between "angles" and "the". Column 6, line 1, delete "the same" and insert --equal first vertical--; line 5 insert --said-- between "ing" and "reflected"; delete "same" and insert --active surfaces--; line 6, delete "the same angle" and insert --equal second vertical angles, said second angles being greater than said first angles,--; line 32, delete "the same" and insert --equal first vertical"; delete "angels" and insert --angles--; line 40, insert --said-- between "lifting" and "reflected"; line 41, delete "same" and insert --active surfaces--; insert --equal second vertical angles, said second angles being greater than said first angles-- and delete "the same angle".

Signed and sealed this 9th day of July 1974.

(SEAL)
Attest:

McCOY M.GIBSON,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents