Nov. 8, 1966 K. FRANCK 3,284,626

LUMINAIRE

Original Filed April 9, 1958 3 Sheets-Sheet 1

Fig. 1.

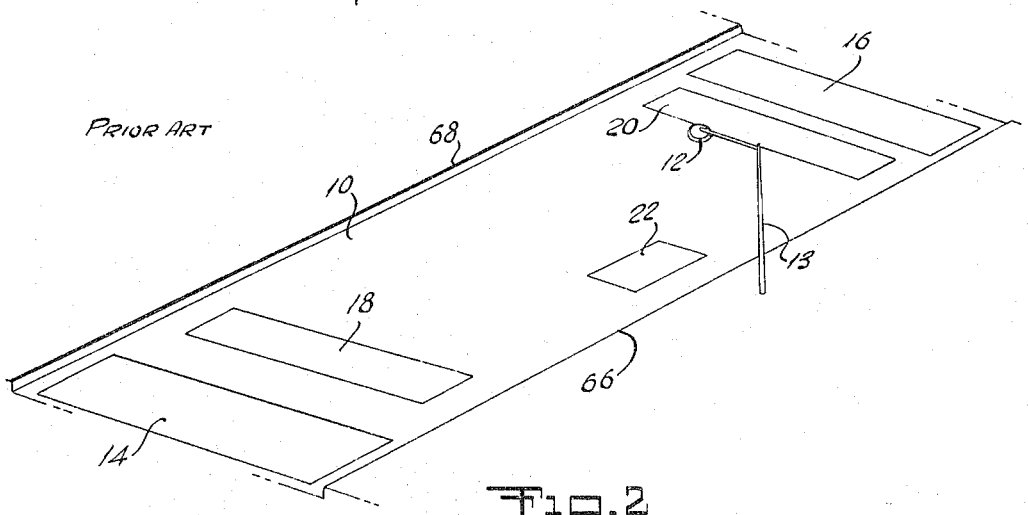
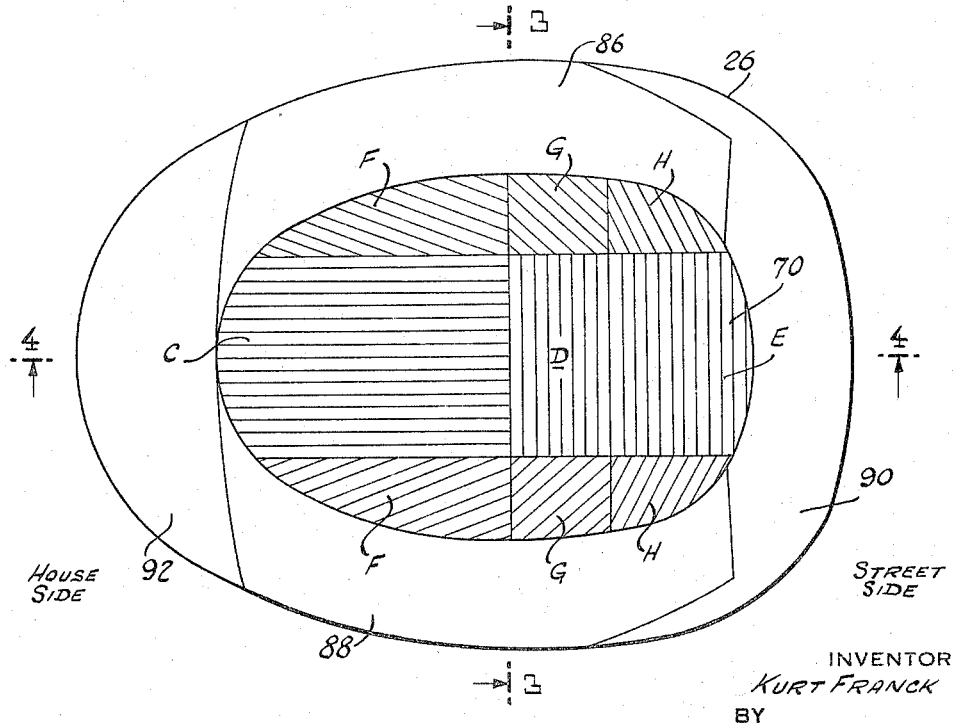


Fig. 2



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LUMINAIRE

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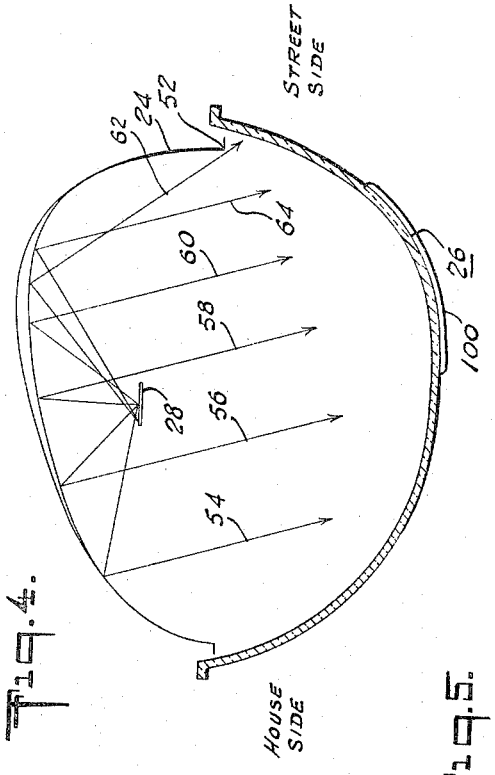

Fig. 4.

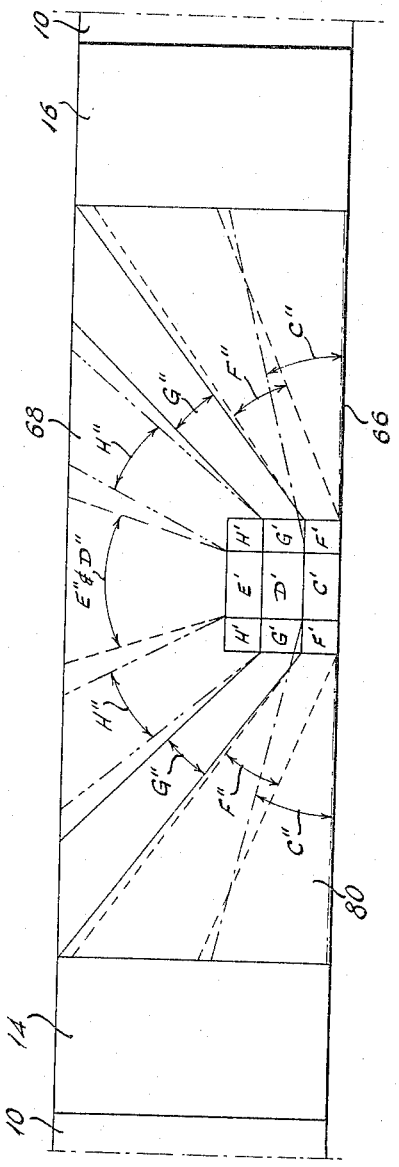

Fig. 5.

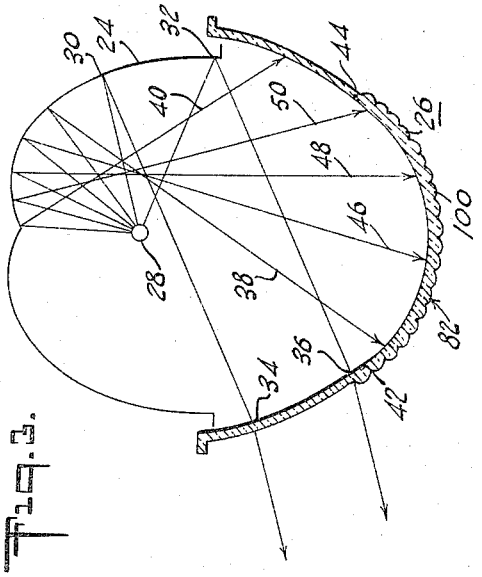

Fig. 3.

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Fig. 6.

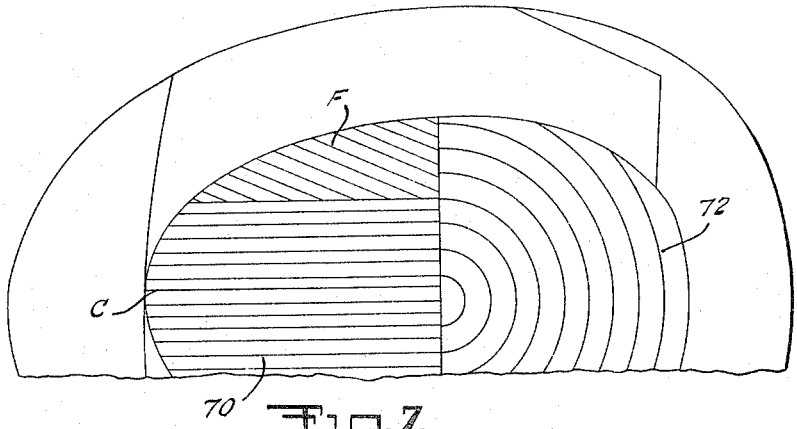
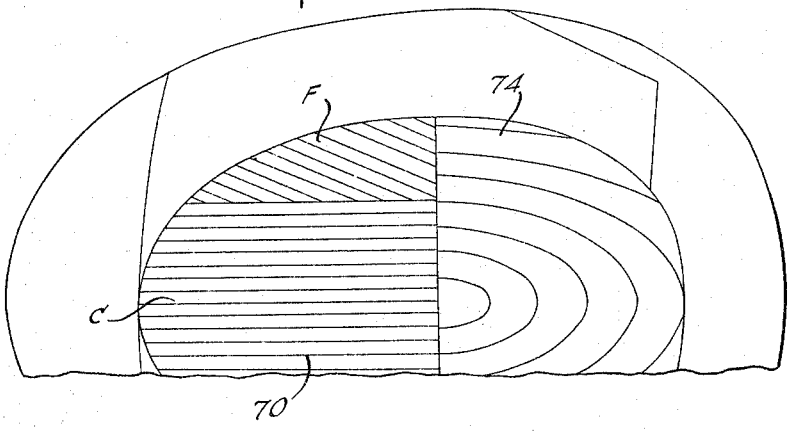


Fig. 7.



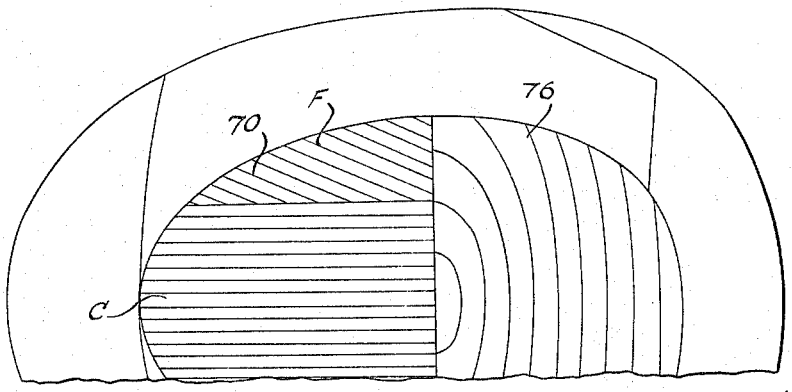


Fig. 8.

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United States Patent Office 3,284,626 Patented Nov. 8, 1966

3,284,626

LUMINAIRE

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Continuation of application Ser. No. 306,970, July 24, 1963, which is a continuation of application Ser. No. 727,352, Apr. 9, 1958. This application Sept. 22, 1965, Ser. No. 496,229

11 Claims. (Cl. 240—25)

This case is a continuation of application, Serial No. 306,970, filed July 24, 1963, now abandoned, which was itself a continuation of application Serial No. 727,352, filed April 9, 1958, now abandoned.

This invention relates in general to luminaires and particularly to a new and useful street luminaire having a novel construction and arrangement of reflector and refractor for effecting even lighting distribution over a wide street area.

While not specifically limited thereto, the present invention finds particular application for use with a street luminaire having a linear light source, preferably a mercury lamp, and in which a substantially ellipsoidally-shaped reflector and refractor are arranged with their longitudinal axes transverse of the street. With luminaires of this general type, it is usual to assign a large area of reflector and refractor to the generation of a high candle-power beam of substantially parallel light rays for illuminating areas on the street remote from the luminaire.

Previously with luminaires of this type, the light pattern produced was in the nature of concentrated rectangular light sections extending transversely of the street at each end and remote from the luminaire, and a generally rectangular light pattern on the street directly beneath the luminaire.

Since relatively large areas of the reflector and refractor surfaces of the luminaire are assigned for the formation of the high candle-power, high angle main light beams, the optical action or expansion of the remainder of the light by the reflector and refractor was considerably limited to an area directly beneath the light. Thus, luminaires of this type produced undesirable bright light areas directly beneath the luminaire and rather poor distribution of light between the high candle-power, well-illuminated extremities of light.

The present invention provides an improved light distribution for luminaires of this general nature by providing a novel refractor arrangement which is effective to explode or more widely distribute the area of light produced directly beneath the luminaire so that it merges with the light produced at the extremities to effect a substantially uniform light distribution over a large rectangular street area.

Accordingly, it is an object of this invention to provide a luminaire having substantially even light distribution over a large rectangular street area.

A further object of this invention is to provide an improved luminaire having a combination reflector and refractor to distribute high candle-power beams of light for illuminating areas remote from the luminaire and having means for producing a substantially uniform light pattern between these remotely illuminated areas.

A further object of the invention is to provide a luminaire which is rugged in construction, simple in design and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects obtained by its use, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a perspective view of a highway or street indicating the lighting pattern produced by conventional luminaire of the high candle-power beam type;

FIG. 2 is a detailed top plan view of a refractor constructed in accordance with this invention;

FIG. 3 is a transverse section taken on the line 3—3 of FIG. 2;

FIG. 4 is a longitudinal section taken on the line 4—4 of FIG. 2;

FIG. 5 is a schematic plan view of a portion of the street area indicated in FIG. 1, indicating an arrangement of refractor lens pattern to effect an expansion and distribution of the highly lighted area beneath the luminaire; and

FIGS. 6 to 8, inclusive, are schematic top plan views of refractors indicating various continuously curving prism path arrangements to effect the desired lighting distribution between the highly illuminated remote light areas produced by the luminaire.

Referring to the drawings in particular, FIG. 1 shows the conventional street lighting patterns produced by luminaires constructed in accordance with the prior art. A long street **10** is provided with a luminaire **12** mounted on a pole **13**. The luminaire **12** is designed to produce a high candle-power beam of substantially rectangular lighted areas **14** and **16** in remote locations from the luminaire.

The luminaire **12** is substantially elliptical in plan and is arranged with the longitudinal axis transverse of the street **10**. A large area of the luminaire reflector and refractor surfaces are assigned to the generation of a high candle-power beam of substantially parallel light rays to effect illumination of the remote areas **14** and **16**. Smaller rectangular light areas **18** and **20**, closer to the luminaire, are usually produced by the lower portions of the ellipsoidally-shaped reflectors of the conventional street luminaires, and these light areas are shifted to locations **14** and **16** by the action of the refractor.

In these conventional luminaires, once the design is committed to incorporate a relatively large area or reflector and refractor surface to the formation of the high candle-power high angle main light beams to produce the areas **14** and **16**, the optical action of the remainder of the reflector and/or refractor surface becomes considerably localized. Such a light distribution usually results in a spot of light **22** of high illumination on the street directly below the luminaire.

A luminaire of this type comprises a generally ellipsoidally-shaped reflector **24** to which is affixed a similarly shaped refractor **26**. An elongated cylindrical light source **28** would normally produce the light patterns at the locations **18** and **20** by rays reflected between points **30** and **32** of the reflector **24**. Corresponding areas **34** and **36** of the refractor **26** accept the parallel beam from the reflector and elevate it in such directions to spread out the high candle-power beam further along the street to produce the illuminated areas **14** and **16**.

The optical action of the remainder of the reflector is considerably circumscribed in directions lengthwise of the street, transversely of the luminaire as shown in FIG. 3. The top section of the reflector is designed to spread the light reflected by it through as wide an angle as possible. This is done by allowing some of the light reflected by the top section of the reflector **24** to pass through the beam section of the refractor **26** as indicated by ray **40** in FIG. 3. However, it is often preferable to limit emergence of this light through the bottom section of the refractor **26** to locations between points

42 and 44 as marked in FIG. 3. Reflected light rays 38, 46, 48 and 50 show typical ray paths reflected from the top section of the reflector 24 and transmitted through the bottom section of the refractor 26.

The luminaire 12 is usually positioned in the street with its longitudinal axis extending across the street. In FIG. 4 the longitudinal profile of the reflector 24 is shaped to direct light forward into the street as far as possible. The restriction in the amount of forward throw of the reflected light is given by the location of the normal front bottom edge 52 of the reflector 24. Rays indicated at 54, 56, 58 and 60 show the reflected path of light which is directed forward into the street. The reflector 24 is shaped to permit sufficient clearance for light rays 62 and 64, which originate at the back end of the linear light source 28, to clear the front edge 52 of the reflector 24.

In considering the luminaire 12 as thus far described and contemplating the direction of the reflected rays from the top of the reflector 24 simultaneously in both transverse and longitudinal directions, it can be seen that the angular range covered by the reflected rays is rather narrow. The reflected rays would normally result in the spot of high illumination at 22 below the luminaire 12.

In accordance with the invention, the refractor 26 is of a novel construction which effects a spreading of the illumination area 22 longitudinally of the street to meet the illumination areas 14 and 16, and transversely of the street to cover the entire width of the street from a near curb 66 to a far curb 68. It has been found, in accordance with the invention, that the most effective way to uniformly illuminate the entire street area between the high illumination beams 14 and 16 is by a novel arrangement of prisms on the inside surface of the refractor 26. It is within the scope of this invention to include two sets of prisms at right angles to each other, one set on the outside of the refractor 26 and the other set on the inside. It was found, however, that regardless of whether the transverse action is accomplished on the inside and the longitudinal action on the outside, or vice versa, that the set of parallel prisms placed on the outside of the refractor will work only to a limited amount and quite inefficiently.

One method of accomplishing the enlargement of the area 22 and the production of uniform lighting between the high beam areas 14 and 16 is indicated in FIG. 6. The lower or central portion 70 of the refractor is made with an arrangement of prisms in continuously curved paths 72. Depending on the amount of angular light ray shift required, both in transverse and longitudinal directions, the prism path is made as a semi-circle as indicated at 72 in FIG. 6, or an elliptical path in alignment with the longitudinal axis, as indicated at 74 in FIG. 7, or with an elliptical path in alignment with the transverse axis, as indicated at 76 in FIG. 8. With the arrangements indicated, refractive power of the prisms may be suitably varied along the path described, to effect the desired light ray direction and intensity to cover the complete street area.

In an actual luminaire refractor construction, it has been found practical to *approximate* the curve path for the prisms as indicated in FIGS. 6 to 8, inclusive, by dividing the bottom portions 70 of the refractor 26 into small areas (as indicated in FIG. 2 and on the left side of FIGS. 6 to 8 inclusive). In FIG. 2 the bottom of the refractor is divided into panels C, D, E, F, G, and H.

The individual action of these prismatic panels is shown somewhat schematically in FIG. 5. Considering that the light rays are directed as illustrated in FIGS. 3 and 4 by the reflector 24, the spot of brilliance 22 beneath the luminaire would appear as projected light divided up into the areas covered by the prism panels C', D', E', F', G' and H' corresponding to the prism panels C, D, E, F, G and H of FIG. 2. The prism panels are chosen in respect to prism surface angles and orientation of the prism rows of each panel to effect the expansion of the light through a rectangular area 80 defined on the street as indicated at FIG. 5. The result is a somewhat discontinuous but thorough coverage of the entire area 80 between the high candle-power beam areas 14 and 16.

The outside surface 82 of the refractor 26 is constructed to provide a minor amount of general diffusion via flutes 100, in order to blend the discontinuous patterns of the panels formed at C'' through H'' (FIG. 5) into a smooth pattern of substantially uniform illumination throughout the area 80.

In the actual construction of the panel system indicated schematically in FIG. 5 and actually in FIG. 2, the panels C through H on the refractor inside surface need not be exactly rectangular. In plan view the prismatic panel section is substantially oval as at 70. Two side portions 86 and 88 of the refractor 26 are committed to the generation of the high candle-power beam producing the illuminated areas 14 and 16. A forward section 90 is effected to afford the projection of the light across the street as is a rear section 92. The individual panels C through H in the oval prismatic section 84 are preferably shaped as shown in the drawing at FIG. 2. It will be noted that the panels C, D and E are essentially rectangular while the panels F, G and H are shaped to blend at their outside edges into the adjoining prismatic beam panels 86 and 88.

Thus the invention provides a luminaire having a novel construction affording uniform illumination between two highly illuminated remote areas.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the invention principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What I claim is:

1. A substantially ellipsoidal refractor comprising sides and end portions and a central bottom portion extending therebetween, said central bottom portion formed of a plurality of prisms arranged in continuous curved rows, said rows being oriented to dispose said prisms for distributing light incident thereon into a uniform elongated rectangular area, some of said prisms extending parallel with respect to the longitudinal center line of said ellipsoidal refractor, others of said prisms extending diagonally with respect to the longitudinal center line of said ellipsoidal refractor and further of said prisms extending in said continuous curved rows from said some of said prisms and said others of said prisms, said further of said prisms extending in curved paths from one side of the longitudinal center line of said ellipsoidal refractor to the other side.

2. A substantially ellipsoidal refractor comprising sides and end portions and a central bottom portion extending therebetween, said central bottom portion having a plurality of discrete prismatic panels, each including a plurality of rows of prisms arranged for deflecting light incident thereon to an area complementary to adjacent associated panels for effecting uniform lighting transversely and longitudinally over an elongated substantially rectangular area, said plurality of rows of prisms in one of said descrete prismatic panels extending centrally of said refractor and parallel with the longitudinal axis thereof, said plurality of rows of prisms of others of said discrete prismatic panels extending on either side of said one panel and diagonally relative to the longitudinal center line of said ellipsoidal refractor, said plurality of rows of prisms of another of said discrete prismatic panels extending transversely relative to the longitudinal center line of said ellipsoidal refractor from one side of said central bottom portion to the other and curving along their lengths toward said plurality of rows of prisms of said one said others of said panels on either side of the longitudinal center line of said ellipsoidal refractor.

3. In a luminaire for street lighting and the like, and including an extended linear light source, a reflector including a portion positioned above said light source, said reflector being substantially elliptical in horizontal section and shaped to direct a large portion of light from said light source laterally and remotely of said luminaire into concentrated beams on each side thereof and the remainder downwardly, a refractor positioned below said reflector and arranged to enclose the bottom of said reflector, said refractor being substantially ellipsoidal; said refractor having sides and end portions and a central bottom portion extending therebetween, a plurality of prisms on said central bottom portion, some of said plurality of prisms extending from one end of said bottom portion in parallel paths and parallel to the longitudinal center line of said ellipsoidal refractor and on either side thereof, others of said plurality of prisms on either side of said first mentioned prisms extending diagonally relative to the longitudinal center line of said ellipsoidal refractor, said plurality of prisms including further prisms extending from said first and second mentioned plurality of prisms in curved paths contiguous with said first and second named plurality of prisms from one side of the longitudinal center line of said ellipsoidal refractor to the other, said prisms distributing light incident thereon from said light source and from said refractor uniformly between the concentrated beams on either side of said luminaire.

4. In the luminaire of claim 3, wherein said paths of said prisms are arranged along substantially semicircular curves.

5. In a luminaire for street lighting and the like, and including a light source, a substantially ellipsoidal reflector above the light source shaped to direct a large portion of light from said source laterally and remotely of said luminaire into concentrated beams on either side thereof and the remainder downwardly, an elongated refractor shaped to enclose the bottom of said reflector; said refractor having sides and end portions and a central bottom portion extending therebetween, said central bottom portion being formed with a plurality of prisms extending longitudinally and diagonally on either side of the longitudinal center line of said refractor at one end thereof and transversely of said central bottom portion at the other end in curved rows contiguous with the longitudinally and diagonally extending portions thereof and distributing light from said light source uniformly between the concentrated light beams on either side of said luminaire.

6. In the luminaire of claim 5, wherein said central bottom portion is formed with a plurality of discrete prismatic panels and each of the panels is constructed and arranged to deflect light to an area complementary to other associated panels and all of the panels in concert effect substantially uniform light distribution between said concentrated beams.

7. In the luminaire of claim 6, wherein said prismatic panels are formed on the light source side of said refractor

and means are provided on the outside of said refractor to diffuse said light directed by complementary panels to effect overlapping and uniformity throughout the lighted area.

8. For use in a luminaire having a reflector and a light source; a substantially ellipsoidal refractor comprising downwardly extending sides and end portions and a central bottom portion extending therebetween at the lowermost portions thereof, said sides comprising means for receiving parallel beams from said reflector and for vertically redirecting the same, said central bottom portion being substantially horizontally orientated and including means for receiving down light from the reflector and light source and for distributing light incident thereon into a substantially uniform elongated rectangular area, said means being at least partially formed of a plurality of prisms arranged in continuous substantially curved rows, for distributing light incident thereon into a uniform elongated between the beams, some of said substantially curved rows of prisms being generated about axes perpendicular to a generally horizontal plane and extending in paths from one side of the longitudinal center line of said ellipsoidal refractor to the other side.

9. The ellipsoidal refractor of claim 8 wherein the curvilinearity of said substantially curved rows of prisms forming said central bottom portion and extending in paths from one side of the longitudinal center line to the other side thereof is approximated in the form of discrete sets of prisms, the prisms of a pair of discrete sets converging diagonally from the sides of said refractor toward one end thereof, and another set of prisms adjacent said one end of said refractor extending from and between the prisms of said pair of discrete sets of prisms across the longitudinal center line of said refractor.

10. The ellipsoidal refractor of claim 8, wherein said curved rows of prisms are positioned adjacent one of said end portions and said light receiving and distributing means further include rows of prisms extending in rectilinear diagonal paths adjacent the other of said end portions on either side of the longitudinal center line of said ellipsoidal refractor.

11. The ellipsoidal refractor of claim 8, wherein said curved prisms are positioned adjacent one of said end portions and said light receiving and distributing means further include rows of prisms adjacent the other of said end portions extending in rectilinear paths parallel to and on either side of the longitudinal center line of said ellipsoidal refractor.

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NORTON ANSHER, *Primary Examiner.*

C. R. RHODES, *Assistant Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,284,626 November 8, 1966

Kurt Franck

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 63, for "descrete" read -- discrete --; line 73, after "one" insert -- and --; column 6, line 19, before "between" insert -- rectangular area --.

Signed and sealed this 12th day of September 1967.

(SEAL)
Attest:

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Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents