May 5, 1964 K. E. FAIRBANKS 3,131,874

LUMINAIRE

Filed Feb. 27, 1962 5 Sheets-Sheet 1

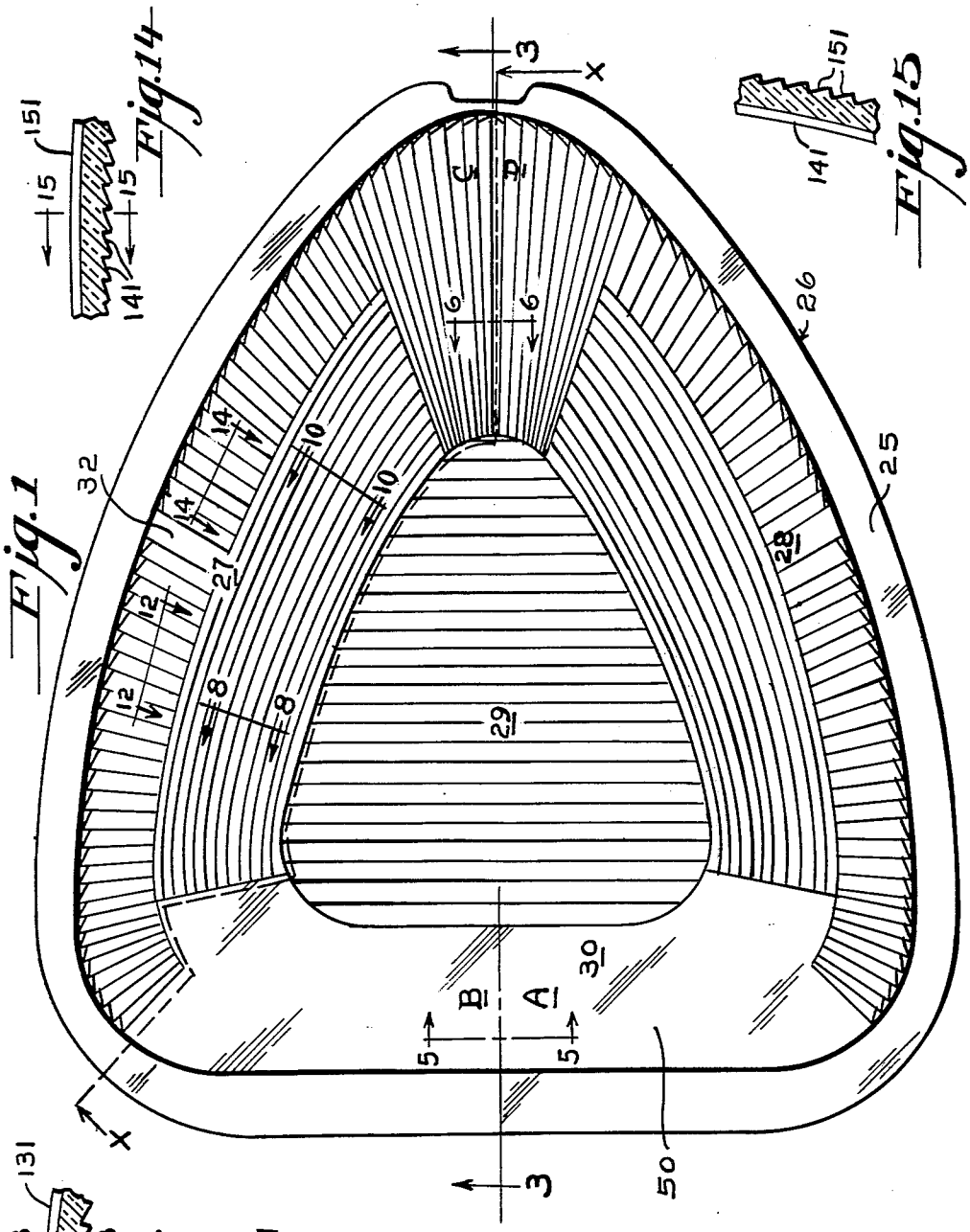


Fig. 1

Fig. 14

Fig. 15

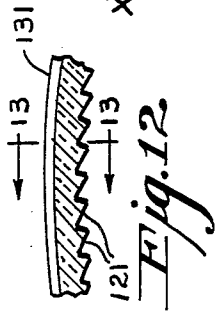


Fig. 12

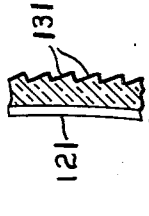


Fig. 13

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May 5, 1964 K. E. FAIRBANKS 3,131,874

LUMINAIRE

Filed Feb. 27, 1962 5 Sheets-Sheet 2

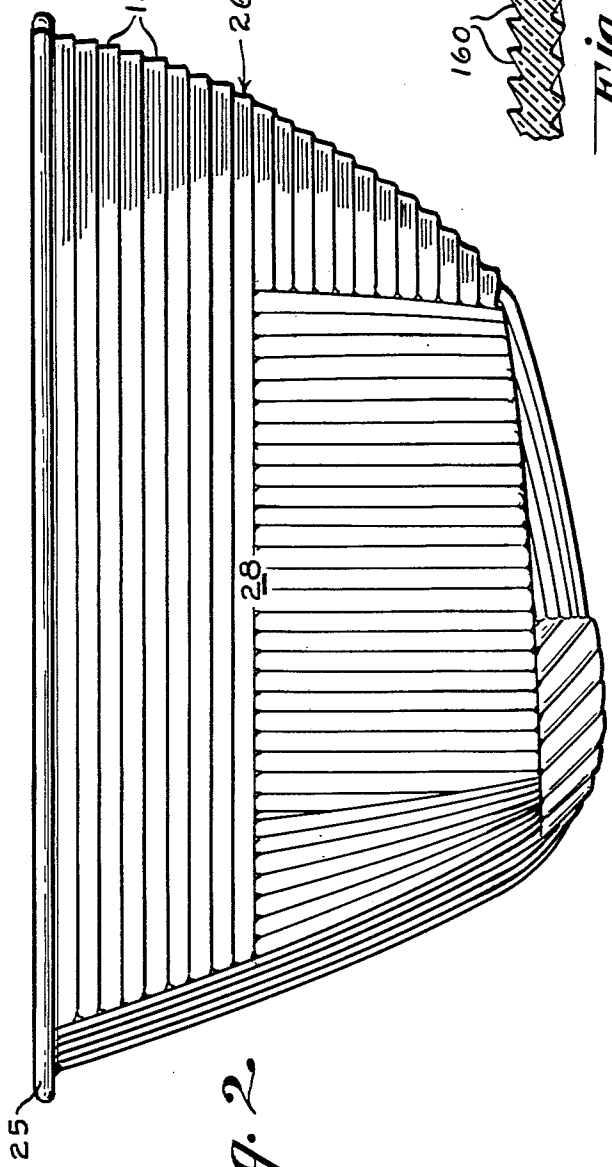


Fig. 2

Fig. 16



Fig. 17

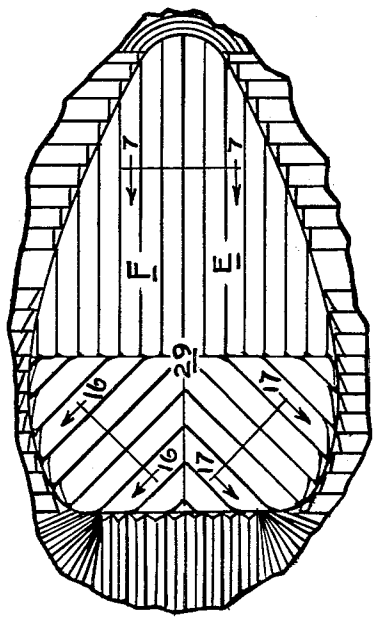


Fig. 4

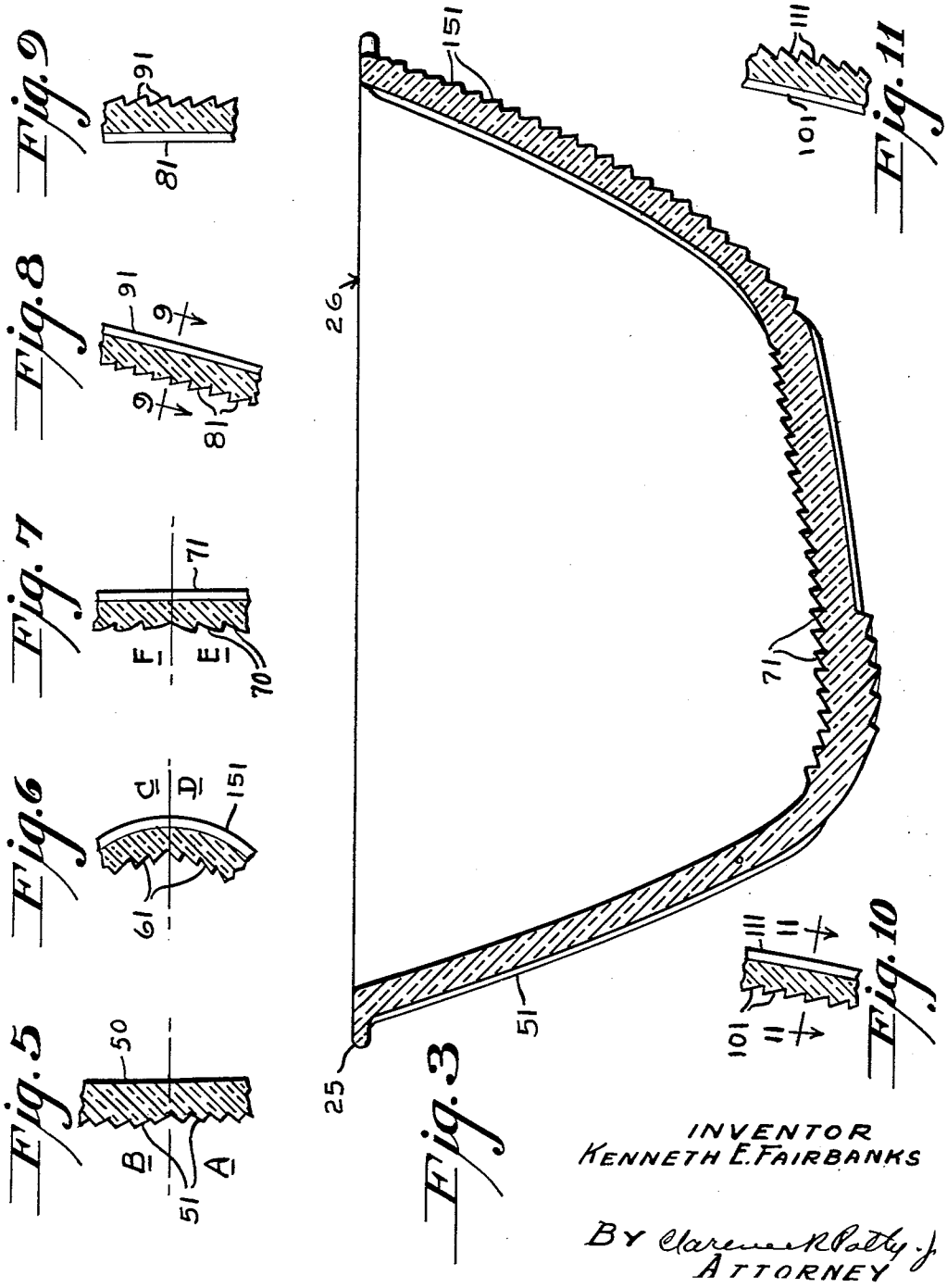
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LUMINAIRE

Filed Feb. 27, 1962 5 Sheets-Sheet 3



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May 5, 1964 K. E. FAIRBANKS 3,131,874

LUMINAIRE

Filed Feb. 27, 1962 5 Sheets-Sheet 4

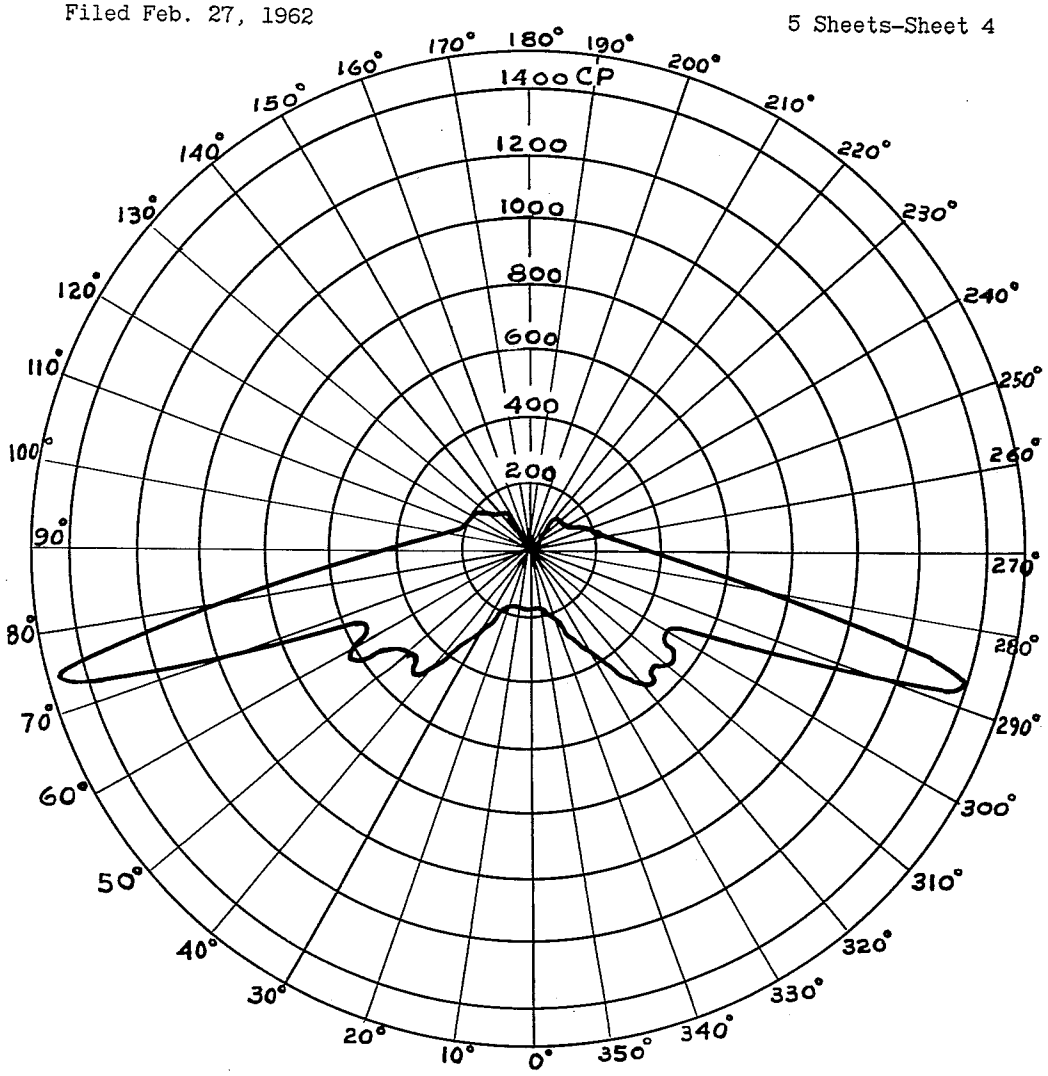


Fig. 18

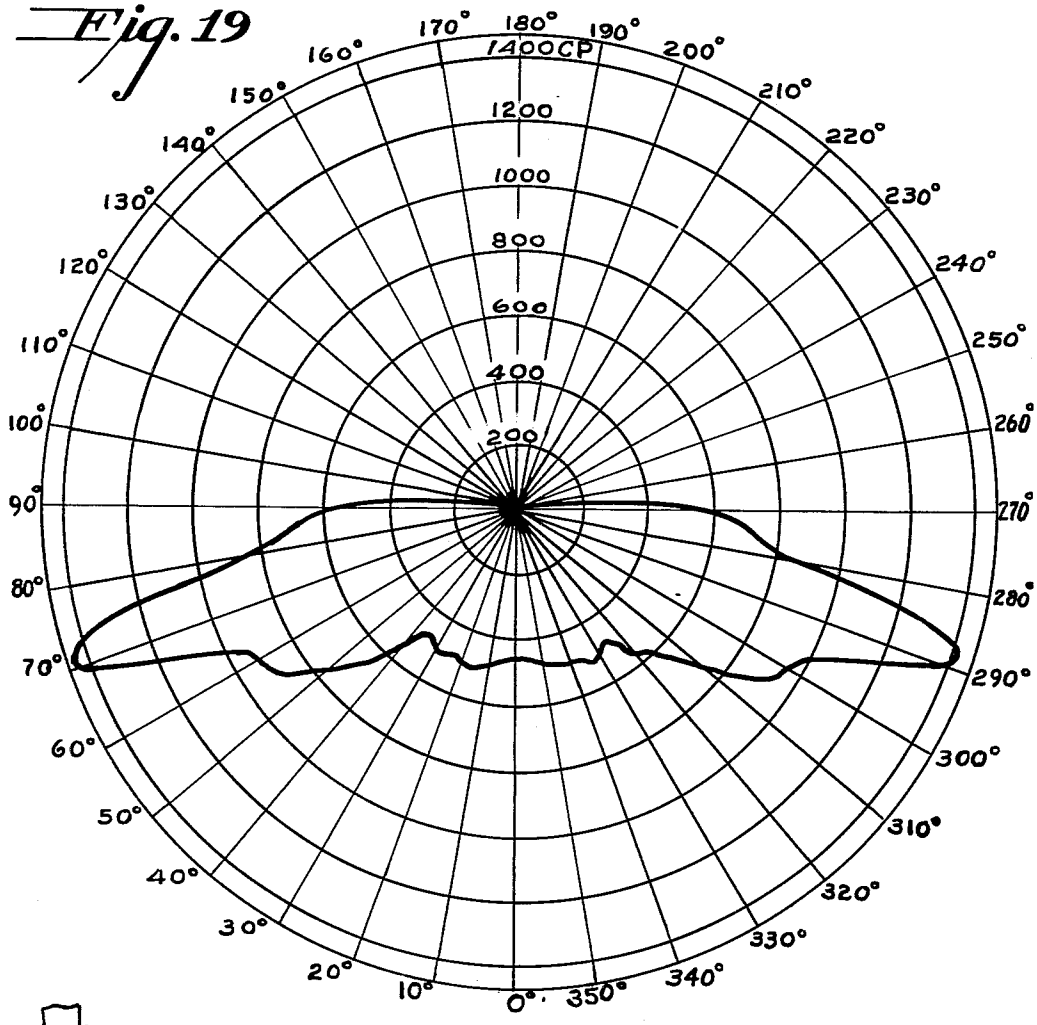
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LUMINAIRE

Filed Feb. 27, 1962 5 Sheets-Sheet 5

Fig. 19



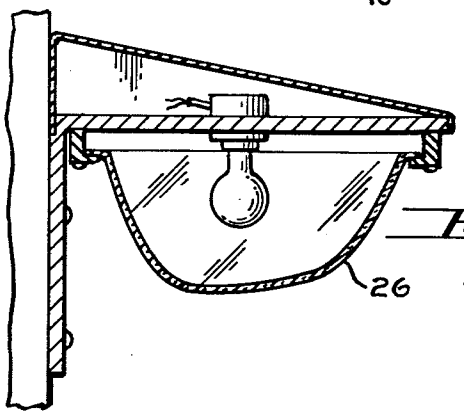


Fig. 20

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LUMINAIRE

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Filed Feb. 27, 1962, Ser. No. 175,965
6 Claims. (Cl. 240—106)

This invention relates to luminaires and more particularly to luminaires and refractors for use therein which are capable of directing substantially all light emitted therefrom throughout 180° in horizontal directions about the luminaire and with its greatest intensity in directions horizontally separated by approximately 148° and at angles of about 72° above nadir.

Such light distribution is especially desirable in luminaires intended to be mounted on a wall and to distribute light throughout an area in front of the luminaire and along the ground adjacent to the wall in both directions from the luminaire, and it is an object of the invention to provide such a luminaire.

This object is accomplished by the provision of a luminaire having a concavo-convex refractor in the general form of a frustum of a triangular pyramid but having slightly curved faces, one face of the frustum having on its exterior surface a series of internally reflecting surface prisms and the other faces having on each surface thereof series of parallel generally triangular refracting surface prisms.

The construction of the luminaire is illustrated in the accompanying drawing, in which:

FIGURE 1 is a plan view of the interior surface of the refractor,

FIGURE 2 is a side elevational view of the refractor,

FIGURE 3 is a sectional view taken on line 3—3 of FIGURE 1,

FIGURE 4 is a fragmentary plan view of the exterior surface of the bottom of the refractor,

FIGURE 5 is a sectional view taken on line 5—5 of FIGURE 1,

FIGURE 6 is a sectional view taken on line 6—6 of FIGURE 1,

FIGURE 7 is a sectional view taken on line 7—7 of FIGURE 4,

FIGURE 8 is a sectional view taken on line 8—8 of FIGURE 1,

FIGURE 9 is a sectional view taken on line 9—9 of FIGURE 8,

FIGURE 10 is a sectional view taken on line 10—10 of FIGURE 1,

FIGURE 11 is a sectional view taken on line 11—11 of FIGURE 10,

FIGURE 12 is a sectional view taken on line 12—12 of FIGURE 1,

FIGURE 13 is a sectional view taken on line 13—13 of FIGURE 12,

FIGURE 14 is a sectional view taken on line 14—14 of FIGURE 1,

FIGURE 15 is a sectional view taken on line 15—15 of FIGURE 14,

FIGURE 16 is a sectional view taken on line 16—16 of FIGURE 4,

FIGURE 17 is a sectional view taken on line 17—17 of FIGURE 4,

FIGURE 18 is a polar diagram showing the lateral distribution of light from the luminaire,

FIGURE 19 is a polar diagram showing the vertical distribution of light from the luminaire, and

FIGURE 20 is a longitudinal sectional view of a luminaire according to the invention.

The refractor **26** of the present invention is symmetric about a plane through its longitudinal axis and perpendicular to the plane of its rim **25** (a plane through line 3—3 of FIGURE 1 and perpendicular to the plane of the paper) and, accordingly the side areas of the refractor will be described with reference to one of the symmetric parts.

As can be seen from the drawing, the refractor of the invention comprises a concavo-convex structure **26** in the general form of a truncated triangular pyramid. The refractor is divided into areas each having an interior surface and an exterior surface, each of which is provided with several series of parallel refracting or reflecting prisms. Side areas **27** and **28** and base area **29**, illustrated in FIGURE 1, contain refracting prisms on both their interior surfaces and their exterior surfaces, while end area **30**, which is intended to be placed facing the well upon which the luminaire is mounted, has a smooth interior surface **50** and an exterior surface having thereon a series of prisms **51**, illustrated in FIGURE 5, having the ability by means of internal reflection to redirect in the direction of a vertical line through the light center substantially all light from the lightcenter falling directly on surface **50**. The configuration of such totally reflecting prisms is well known in the art and, for that reason, will not be further discussed.

Side areas **27** and **28** of the refractor will be described with reference to area **27**, it being understood that area **28** is symmetric therewith and functions similarly.

It is a function of the side areas to direct most of the light from the luminaire along the ground adjacent to the wall upon which the luminaire is mounted. Since it is an object of the invention to spread light on the ground along the length of the wall, for example, along a sidewalk near the wall, the luminaire is designed to emit the greatest amount of light at horizontal angles approximately 16° from the wall surface and at vertical angles approximately 72° above nadir.

This light distribution is illustrated in FIGURES 18 and 19. FIGURE 18 gives the lateral distribution of candle power values for light emitted from the luminaire in a cone having its apex at the light center and having its surface 72° about nadir, that is the light rays form angles of 18° with the horizontal. The luminaire is mounted with its longitudinal axis along the 0° line on the diagram, and the candle power curve is seen to form a pattern which is substantially symmetric about this line and which gives maximum candle power ratings at angles of approximately 74° on each side thereof. FIGURE 19 gives the vertical candle power values for the same luminaire for 74° lateral, that is, the candle power distribution through 180° from nadir to zenith in each of two vertical planes through the maximum candle power vectors of FIGURE 18 and comprises the substantially symmetric lobes on each side of the 0°–180° line.

In order to effect such distribution the side and the bottom areas are constructed as follows:

Side area **27**, which is the area delineated generally by the broken line X—X of FIGURE 1, comprises two sections. The first of these is an upper and end section which comprises that portion having on its interior surface a plurality of prisms generally perpendicular to rim **25** of the refractor, as indicated in FIGURE 1. These prisms are shown as prisms **61**, **121**, and **141** of FIGURES 6, 12, and 14 respectively, and have their bases, or their thickest portions, at their edges which are nearest to a central "bullseye" area, designated as **32** in FIGURE 1. Thus, light rays passing through this section tend to be bent in the direction of this central area. Since greater refractive power is required to bend in this direction light which falls nearer the ends of this section, the prisms increase in pitch with increasing distance from the central area. Central area **32** corresponds to the 74° lateral angle referred to in reference to FIGURES 18

and 19. On the exterior surface of this section is a plurality of prisms **131** and **151**, generally parallel to rim **25** and illustrated respectively in FIGURES 13 and 15. These prisms have their maximum thicknesses at their edges which are farthest from rim **25** and therefore bend light in directions away from the rim.

The second section of side area **27**, which will be referred to as the lower section, has an interior surface having a series of prisms generally parallel to rim **25**, as shown in FIGURE 1. The configurations of these prisms are illustrated as prisms **81** and **101** of FIGURES 8 and 10, respectively. These prisms have their thickest edges nearest rim **25** and hence tend to bend light in the direction of the rim. On the exterior surface of this lower section is a series of prisms having an arrangement similar to that of prisms **121** and **141** of the interior surface of the upper and end section of area **27**. They are generally perpendicular to rim **25** and have their thickest edges nearest a central area which is a continuation of area **32** of FIGURE 1 and tend to cause light to converge in this direction. They are illustrated as prisms **91** and **111** of FIGURES 9 and 11 respectively.

Base area **29**, having its interior and exterior surfaces illustrated in plan view in FIGURES 1 and 4 respectively, refracts light away from the area directly beneath the luminaire and spreads it away from and beside the wall on which the luminaire is mounted. On the interior surface of base area **29** are a plurality of prisms **71**, illustrated in section in FIGURE 3, and generally parallel to the surfaces of end area **30**. Prisms **71** are thickest at their edges farthest from an area **30** and hence refract light away therefrom. The refractive power of the prisms decreases with increasing distance from base area **30**. The exterior surface of base area **29** is divided into three sections, illustrated in section in FIGURES 7, 16 and 17 respectively. The prisms **70** of FIGURE 7, which together with that part of the interior surface opposed thereto comprise the forward section of the base area, have slightly curved surfaces and consequently spread out the light passing therethrough by causing light rays to be bent in the direction of the centers of the respective prisms and subsequently to cross and diverge. The inclination of the surfaces of prisms **70**, which are thickest at their edges farthest from the longitudinal axis of the refractor, increases with increasing distance from the center, and hence the cumulative effect of prisms **70** and **71** is to cause light emitted from this section to be spread over a wide area below and in front of the luminaire. Prisms **160** and **170** of FIGURES 16 and 17 respectively, which together with that part of the interior surface opposed thereto comprise the base section of base area **29**, are oriented at angles of approximately 45° with the longitudinal axis of the luminaire and are thickest at their edges farthest from end area **30**. Their function is to bend outwardly from the wall and laterally from the luminaire light which would otherwise fall on the wall or directly under the luminaire.

It will be observed that the term "prism" is not used herein in its strict geometric sense, since the structures so described are not composed solely of plane surfaces but are of necessity curved to fit the curved surface areas of the refractor. In addition, as has been pointed out, certain prisms have refracting surfaces which are curved in cross section as well.

Side areas **27** and **28** are formed with two sections as described in order to avoid angular configurations which would make it impossible to remove the finished refractor from a one-piece block mold. It will be apparent to those familiar with the art that, if it is desired to use a separable mold, the side areas may equally well be made with all horizontally deflecting prisms on one surface and all vertically deflecting prisms on one surface and all vertically deflecting prisms on the other surface.

It will be further apparent that end area **30** may comprise a reflecting surface such as a silvered surface rather than the illustrated totally reflecting prisms.

In order to direct the main beam from the luminaire at 74° in a horizontal direction from the longitudinal axis of the luminaire, the light center of the luminaire is placed so that the vertical "bull's eyes," toward which the vertical prisms of the side and end areas refract light, and the longitudinal axis subtend angles of 74° at the light center. It will be understood, however, that modifications in the precise light distribution illustrated may be effected within the scope of the invention by variation of the location of the light center within the luminaire.

I claim:

1. A refractor in the general shape of a hollow truncated triangular pyramid having an open base forming a rim, and comprising an end area on one generally quadrangular face thereof, two symmetric side areas on the remaining generally quadrangular faces thereof, and a base area on the generally triangular face thereof, each of said side areas comprising two sets of surface prisms, the prisms of one of said sets having edges substantially parallel to said rim and having bases nearest a line on their respective side area substantially parallel to said rim and the other of said sets having edges substantially perpendicular to said rim and having base edges nearest a line on their respective side area substantially perpendicular to said rim, said end area having a reflecting surface, and said base area comprising four sets of surface prisms, the first set comprising a series of prisms having edges substantially parallel to said end area of said refractor and having bases at their edges farthest from said end area, the second set comprising a series of parallel prisms having edges substantially perpendicular to said end area and having surfaces which are curved in cross section, and each of said third and fourth sets comprising a series of parallel prisms, the prisms of said third and fourth sets having edges substantially perpendicular and forming angles of approximately 45° with the prisms of said first and second sets.

2. A refractor according to claim 1 in which said second set of base area prisms have base edges farthest from a line in said base area which is substantially perpendicular to said end area and which divides said base area into two substantially equal parts.

3. A refractor in the general shape of a hollow truncated triangular pyramid having an open base forming a rim, and comprising an end area on one generally quadrangular base thereof, two symmetric side areas on the remaining generally quadrangular faces thereof and a base area on the generally triangular face thereof, each of said side areas comprising two sets of surface prisms, the prisms of one of said sets having edges substantially parallel to said rim and having base edges nearest a line on their respective side area substantially parallel to said rim and the other of said sets having edges substantially perpendicular to said rim and having base edges nearest a line on their respective side area substantially perpendicular to said rim, said end area having a reflecting surface, and said base area comprising a forward section and a base section, said base area having on its interior surface a series of prisms having edges substantially parallel to said end area of said refractor and bases at their respective edges farthest from said end area, said forward section having an exterior surface comprising a series of prisms having edges substantially perpendicular to said end area and having surfaces which are curved in cross section, and said base section of said base area having an exterior surface comprising two series of parallel prisms, the edges of prisms of each of said series being respectively perpendicular to the edges of the prisms of the other of said series and forming angles of approximately 45° with the edges of said prisms of the exterior surface of said forward section of said base area, and having bases at their edges farthest from said end area.

4. A refractor according to claim 3 in which said end

area has a smooth interior surface and an exterior surface comprising a series of parallel internally reflecting prisms having edges generally perpendicular to said rim.

5. A refractor according to claim 3 in which the said prisms of the exterior surface of the forward section of the base area have base edges farthest from a line in said base area which line is substantially perpendicular to said end area and divides said base area into two substantially equal parts.

6. A refractor according to claim 3 in which each of said side areas comprises a lower section and an upper and end section, said lower section having an interior surface comprising a series of prisms having edges substantially parallel to said rim and having base edges nearest said rim and an exterior surface comprising a series of prisms having edges substantially perpendicular to said rim and having base edges nearest a line substantially

perpendicular to said rim and dividing said side area into two parts, and said upper and end section having an exterior surface comprising a series of prisms having edges substantially parallel to said rim and having base edges farthest from said rim and an interior surface comprising a series of prisms having edges substantially perpendicular to said rim and having base edges nearest said line dividing said side area into two parts.

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