May 16, 1967 F. M. NEAL ETAL 3,320,415

STREET LIGHT REFRACTOR

Filed May 17, 1965 4 Sheets-Sheet 1

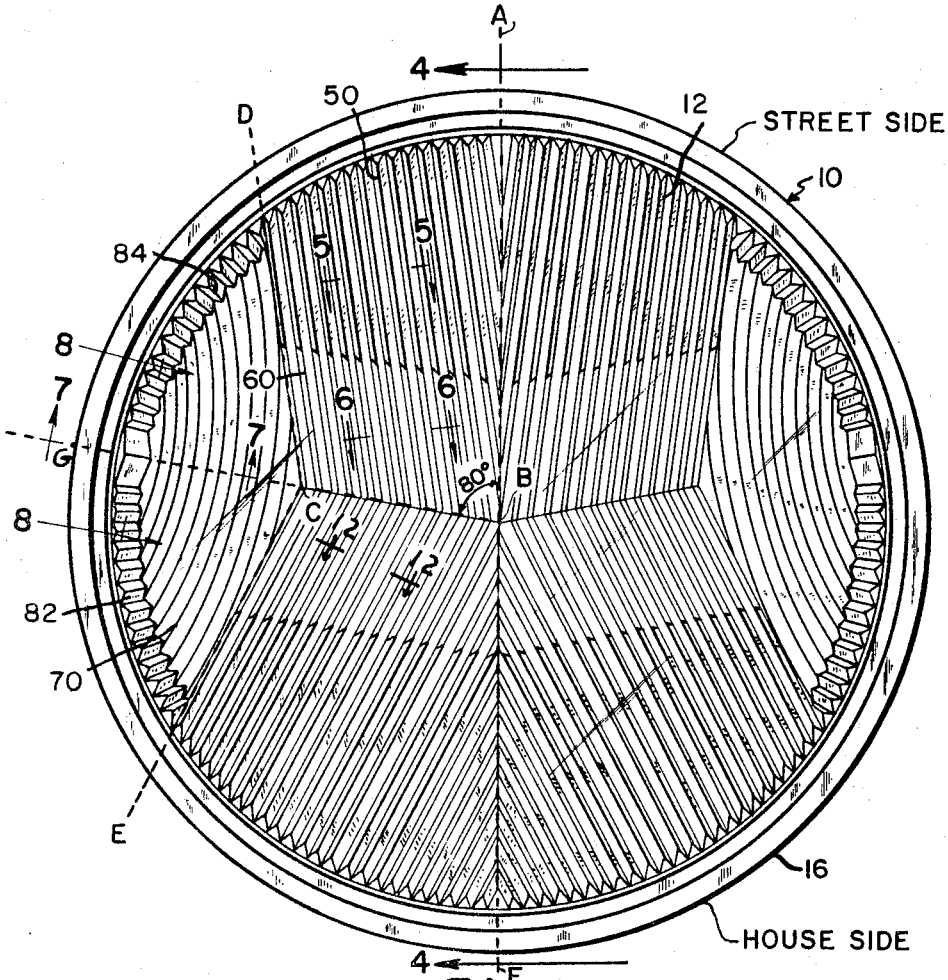

Fig. 1

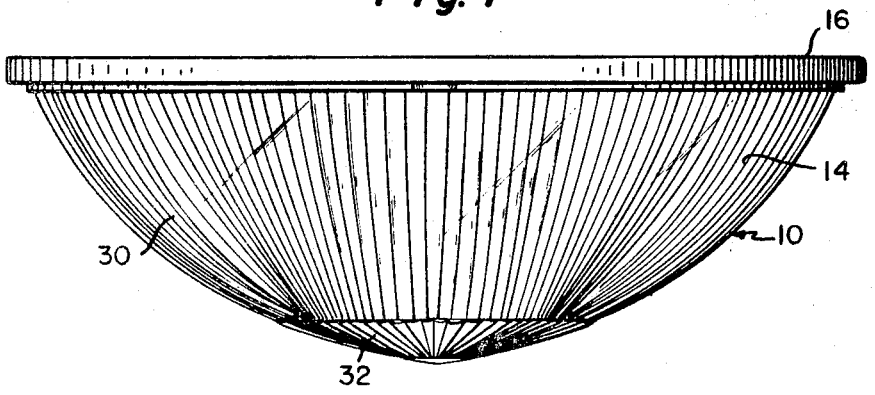

Fig. 2

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STREET LIGHT REFRACTOR

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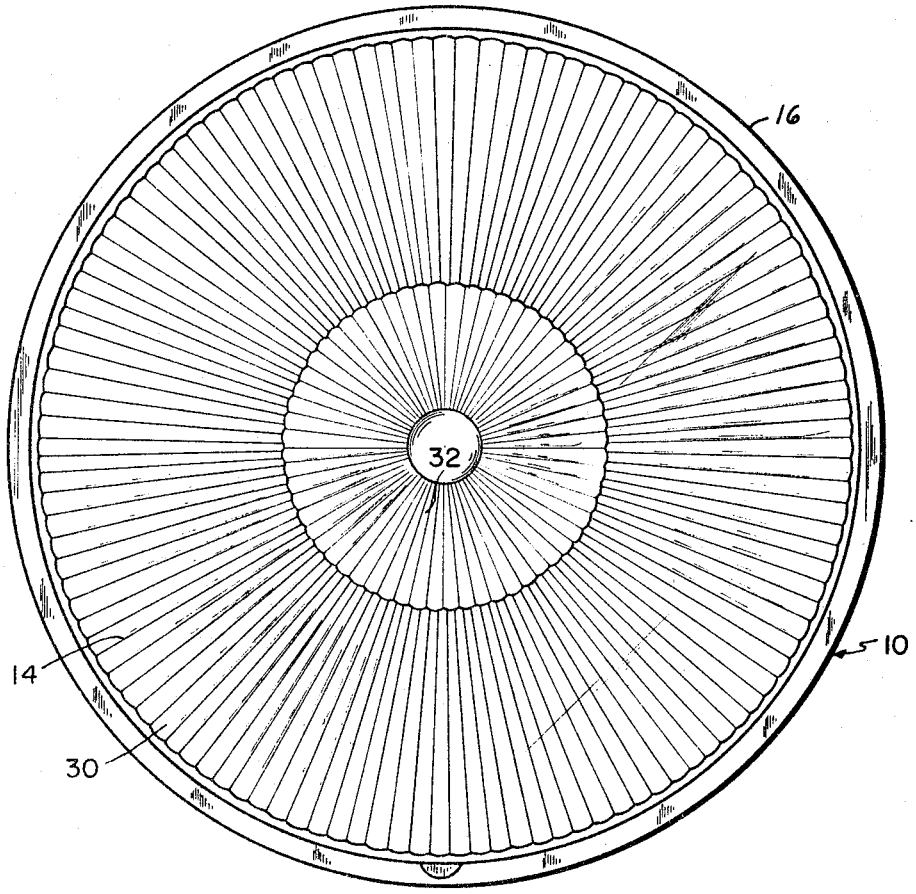

Fig. 3

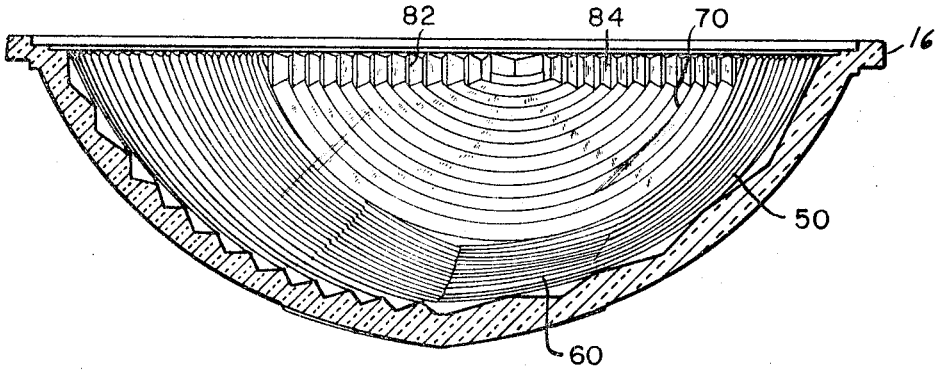

Fig. 4

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STREET LIGHT REFRACTOR

Filed May 17, 1965 4 Sheets-Sheet 3

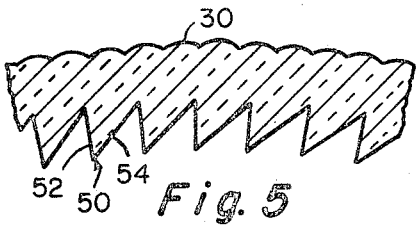

Fig. 5

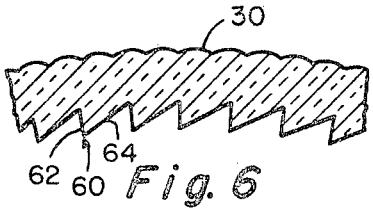

Fig. 6

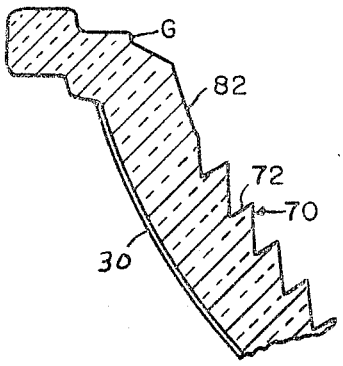

Fig. 7

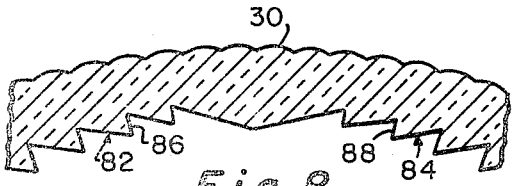

Fig. 8

Fig. 12

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STREET LIGHT REFRACTOR

Filed May 17, 1965 4 Sheets-Sheet 4

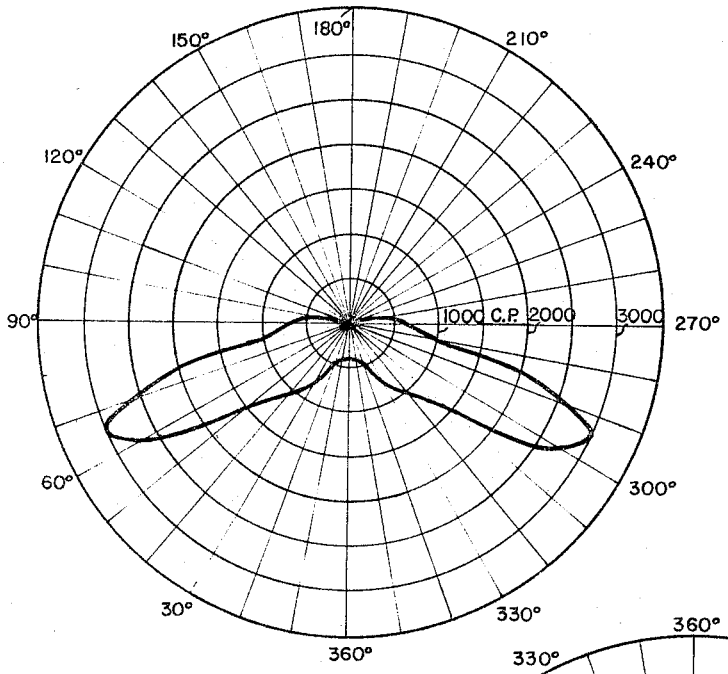

Fig. 9

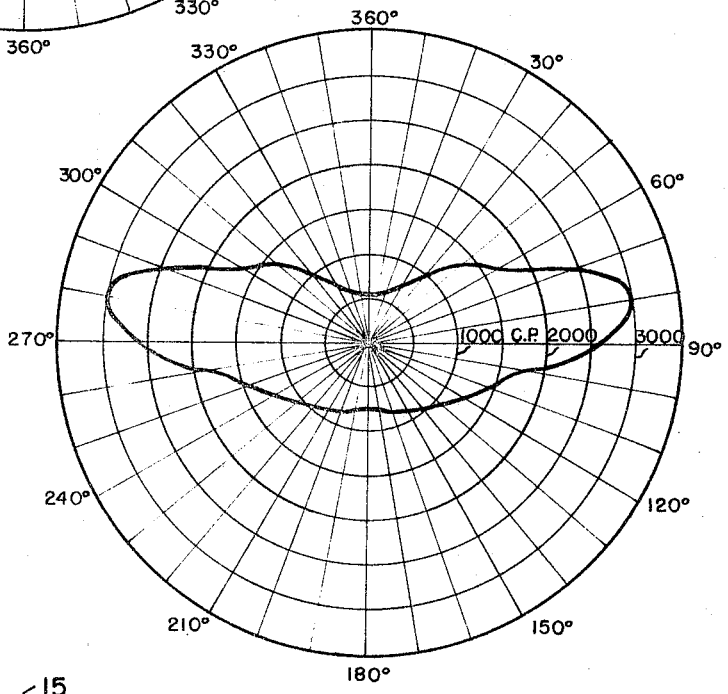

Fig. 10

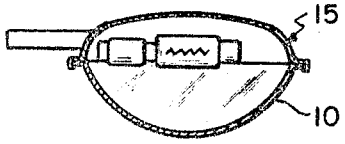

Fig. 11

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3,320,415

STREET LIGHT REFRACTOR

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6 Claims. (Cl. 240—106)

ABSTRACT OF THE DISCLOSURE

A luminaire employing a glass refractor in the form of a portion of a sphere having an inner surface configuration which is symmetric about a plane. Each symmetric half has refracting prisms located in particular relation to a plane forming an angle of about 80° with the plane of symmetry and about 160° with the corresponding plane of the other symmetric half. The outer surface of the refractor is covered with radial convex light-diffusing flutes. The luminaire directs light in two main beams separated horizontally by about 160°.

This invention relates to luminaires and more particularly to luminaires and refractors for use therein which are capable of directing light from a location along the side of a street out onto the street in two main beams having their maximum candle powers at approximately 66° above nadir and separated by approximately 160° horizontally.

This object is accomplished by the provision of a luminaire employing a concavo-convex refractor with surfaces in the general form of portions of a sphere, the inner surface of the refractor being symmetric about a plane perpendicular to the rim of the refractor, the inner surface comprising sets of refracting prisms located in particular relationships with regard to two planes through the center of the refractor perpendicular to the rim of the refractor and forming angles of approximately 160° with one another and 80° with the plane of symmetry, and the outer surface of the refractor having thereon a series of radially extending transversely curved light-diffusing flutes.

The invention will be described in detail with reference to the accompanying drawing, in which:

FIGURE 1 is a plan view of the inner concave surface of the refractor of the present invention,

FIGURE 2 is an end elevational view of the refractor,

FIGURE 3 is a plan view of the outer convex surface of the refractor,

FIGURE 4 is a sectional view of the refractor taken on line 4—4 of FIGURE 1,

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

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

FIGURE 7 is a fragmentary sectional view taken on line 7—7 of FIGURE 1,

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

FIGURE 9 is a polar diagram illustrating the vertical candle power distribution of light from the luminaire at its horizontal locations of maximum intensity,

FIGURE 10 is a polar diagram illustrating the horizontal candle power distribution of light from the luminaire at its vertical angle of maximum intensity,

FIGURE 11 is a longitudinal sectional view of the luminaire of the invention, and

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

Referring to the drawing, refractor **10** comprises a glass body having a concave inner surface **12** and a convex outer surface **14**. Inner surface **12** is symmetric about a plane through line 4—4 of FIGURE 1 and perpendicular to the rim **16** of the refractor. Due to this symmetry, only the left symmetric half of the inner surface of the refractor, i.e., the half of the left side of line 4—4 of FIGURE 1, will be described.

As illustrated in FIGURE 1, the left symmetric half of the inner surface of the refractor can be considered to comprise two main portions. The first such portion is the central portion lying between broken lines DE and AF. The second such portion is the side portion defined by broken line DCE and the rim of the refractor. The central portion comprises two sets of prisms, the prisms within each set being parallel to the remaining prisms of the same set and joining the prisms of the other set at their ends along line CB, which forms an angle of 80° with the plane of symmetry of the refractor inner surface. A plane through line CB perpendicular to rim **16** of the refractor and passing through the center B of the refractor would intersect the rim at point G. The prisms of the central portion DCEFBA of the inner surface of the left symmetric half of the refractor, as well as the prisms of the side portion DCEG of the refractor are oriented to refract light rays passing through the refractor to render the rays generally parallel to the said plane passing through line CB. Thus, as illustrated in FIGURE 10, wherein the luminaire **15**, illustrated in FIGURE 11, is located at the center of the diagram with the plane of symmetry of refractor **10** along the 360°–180° line of the diagram and its street side located on the 360° side of the diagram, the maximum horizontal intensity of the illumination of the refractor falls along the 80° and 280° lines of the diagram, which are separated from the plane of symmetry of the refractor by 80°, that is, along lines corresponding to line GCB and a similar symmetric line on the right side of the refractor. FIGURE 10 illustrates the candle power distribution of a luminaire employing a 175 watt light source and the illustrated refractor.

FIGURE 9 illustrates the vertical light distribution of the same luminaire, candle powers being measured in vertical planes passing through the refractor center and the horizontal locations of maximum light intensity illustrated in FIGURE 10, i.e., along the 80° and 280° lines of FIGURE 10.

As illustrated in FIGURES 5 and 6, prism segments **50** and **60** of the central portion of the inner surface of the refractor have their bases **52** and **62**, respectively, located along their edges nearest point G on the refractor. Thus, when the refractor is oriented with rim **16** horizontal and at the top of the refractor, light rays passing through refracting surfaces **54** and **64** of prism segments **50** and **60** will be bent upwardly and toward a vertical plane passing through line GCB. In order to obtain greater refraction of those rays passing through prism segments **50** than those rays passing through prism segments **60**, refracting surfaces **54** are steeper than refracting surfaces **64**. Such increased refracting power is necessary in peripheral areas of the refractor in order to redirect by a sufficient amount those light rays which would otherwise fall farthest from the desired areas. The prisms **120** of area ECBF are similar to the prisms of area DCBA, as illustrated in FIGURE 12, and similarly direct light upwardly and toward a vertical plane through line GCB.

The side portion DCEG of the inner surface of the left symmetric half of the refractor has thereon a plurality of curved prisms **70** which have edges generally perpendicular to a plane through line GCB at their intersections therewith and which have their bases **72** along their edges nearest point G, as illustrated in FIGURE 7, such that light rays passing therethrough are refracted upwardly and in the direction of a plane through line GCB. The

part of side portion DCEG which borders on rim **16** has thereon two sets of straight prisms **82** and **84** having edges generally perpendicular to rim **16** and generally parallel to the plane through line GCB. The bases **86** and **88** of prisms **82** and **84**, respectively, are along their edges nearest said plane. The refracting power of prisms **82** and **84** increases with increasing distance from point G.

On the outer surface of refractor **10** are a plurality of contiguous radially extending convex flutes **30** and **32**. As illustrated in FIGURES 5, 6, 8 and 12, flutes **30** and **32** are outwardly convex in transverse cross-section. Thus, light rays passing therethrough tend to be spread throughout varying angles, thereby producing a smooth pattern of illumination from the luminaire. Flutes **30** and **32** may be concave rather than convex.

It will be appreciated that the prisms and flutes on the inner and outer surfaces of the present refractor cause both horizontal concentration of light emitted by the luminaire into two main beams, as illustrated in FIGURE 10, and also at the same time lift the light, so that light which would otherwise fall largely beneath the luminaire is directed into main beams along the street in directions corresponding to the 80°–280° lines of FIGURE 10. The fact that the two main beams are separated by 160°, rather than 180°, results in the directing of light out onto the street when the luminaire is located at the curb thereof.

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.

If desired, the surface configurations of the concave and convex surfaces of the refractor may be reversed by those skilled in the art to produce substantially the same results achieved by the illustrated refractor. That is, the above-described refracting prisms may be formed on the convex surface, while the light-diffusing flutes are formed on the inner surface.

Inasmuch as the form of the luminaire and refractor of the present invention may vary from that described above as a preferred embodiment of the invention, it is intended that the scope of the invention be limited only by the scope of the appended claims.

We claim:

1. A refractor in the general shape of a portion of a sphere defined by a rim, said refractor comprising an inner concave surface and an outer convex surface, one said surface comprising two halves symmetric about a plane of symmetry perpendicular to said rim, each said half comprising a central portion and a side portion, each said central portion comprising two sets of prisms, the prisms within each set having edges parallel to the edges of the remaining prisms of the same set and joining the prisms of the other set at the ends thereof and along a line lying in a second plane generally perpendicular to said rim and forming an angle of about 80° with said plane of symmetry of said refractor, said second planes of said halves forming an angle of about 160° with one another, said prisms of each said central portion having bases along their edges nearest a point defined by the intersection of said rim with said second plane of the same said central portion, said side portion of each said symmetric half having thereon a plurality of curved prisms generally perpendicular to said second plane of the same symmetric half at their intersections therewith and having bases along their edges nearest said point, said central portion of each said symmetric half being bounded by said plane of symmetry, said rim and said side portion of the same said symmetric half, the other said surface of said refractor comprising a plurality of radially extending light-diffusing flutes curved in transverse cross-section.

2. A refractor in the general shape of a portion of a sphere defined by a rim, said refractor comprising an inner concave surface and on outer convex surface, said inner concave surface comprising two halves symmetric about a plane of symmetry perpendicular to said rim, each said half comprising a central portion and a side portion, each said central portion comprising two sets of prisms, the prisms within each set having edges parallel to the edges of the remaining prisms of the same set and joining the prisms of the other set at the ends thereof and along a line lying in a second plane generally perpendicular to said rim and forming an angle of about 80° with said plane of symmetry of said refractor, said second planes of said halves forming an angle of about 160° with one another, said prisms of each said central portion having bases along their edges nearest a point defined by the intersection of said rim with said second plane of the same said central portion, said side portion of each said symmetric half having thereon a plurality of curved prisms generally perpendicular to said second plane of the same symmetric half at their intersections therewith and having bases along their edges nearest said point, said central portion of each said symmetric half being bounded by said plane of symmetry, said rim and said side portion of the same said symmetric half, said outer convex surface of said refractor comprising a plurality of radially extending light-diffusing flutes curved in transverse cross-section.

3. A refractor according to claim **2** in which said prisms of said central portion of said inner surface of each said symmetric half are formed in two segments, the segments nearer the rim of said refractor having higher refracting powers than the segments of the same prisms farther from said rim.

4. A refractor according to claim **2** in which each of said flutes is convex in transverse cross-section.

5. A refractor according to claim **2** in which said side portions of said inner surfaces of said refractor each includes an edge part bordering on said rim, said edge part having thereon two sets of prisms, one said set being on each side of said second plane of the same said side portion, said prisms of each said set having edges generally perpendicular to said rim and having bases along their edges nearest said second plane.

6. A refractor according to claim **5** in which said prisms of each said edge part of said side portion increase in refracting power with increasing distance from said second plane.

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