Nov. 1, 1949. K. FRANCK 2,486,558

STREET LIGHTING LUMINAIRES AND REFRACTORS THEREFOR

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Fig. 1.

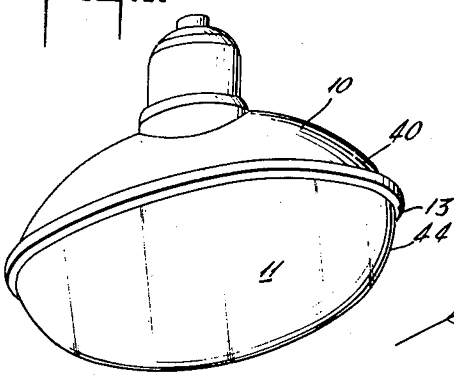


Fig. 2.

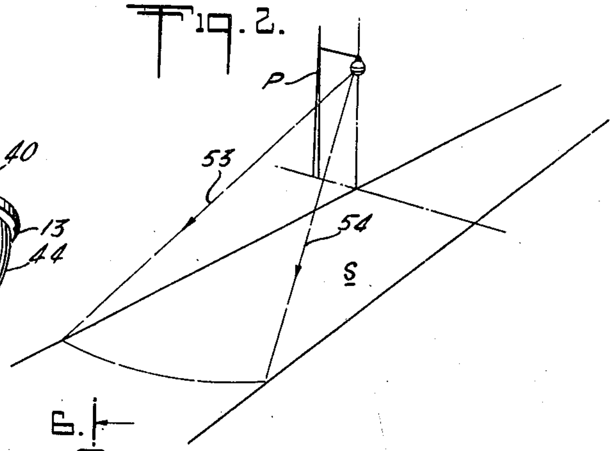


Fig. 3.

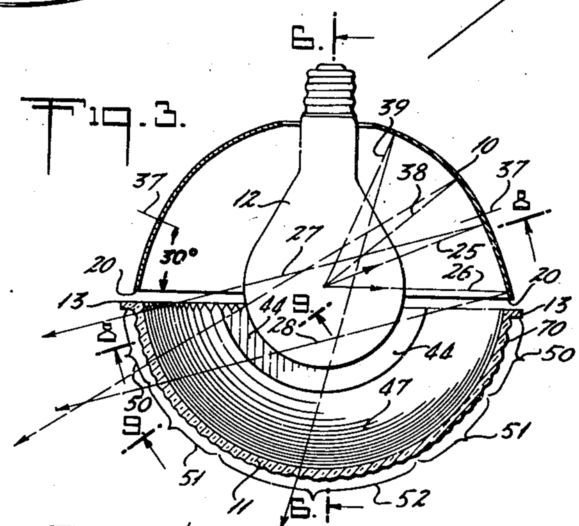
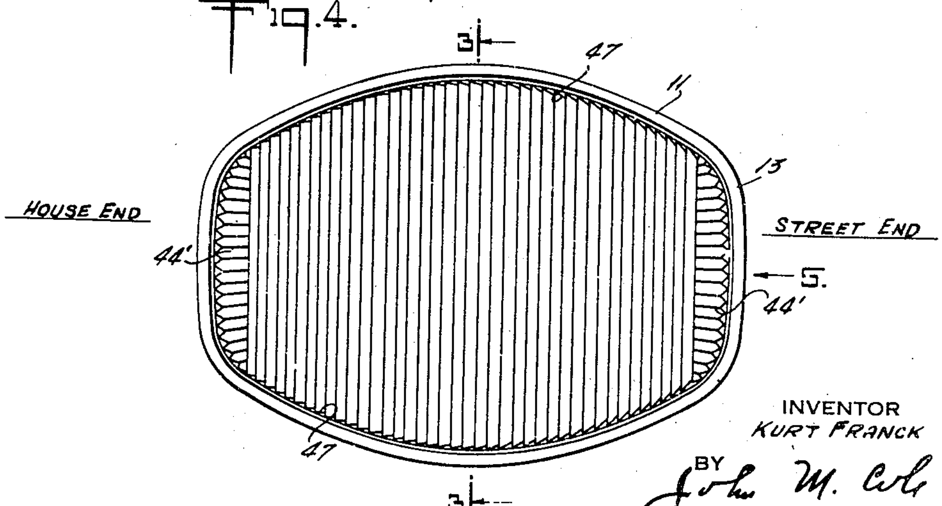


Fig. 4.



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STREET LIGHTING LUMINAIRES AND REFRACTORS THEREFOR

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Fig. 5.

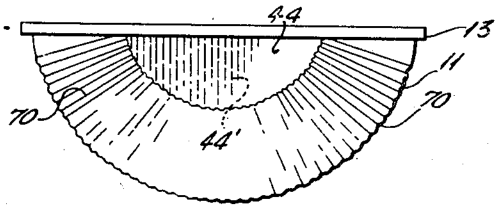


Fig. 6.

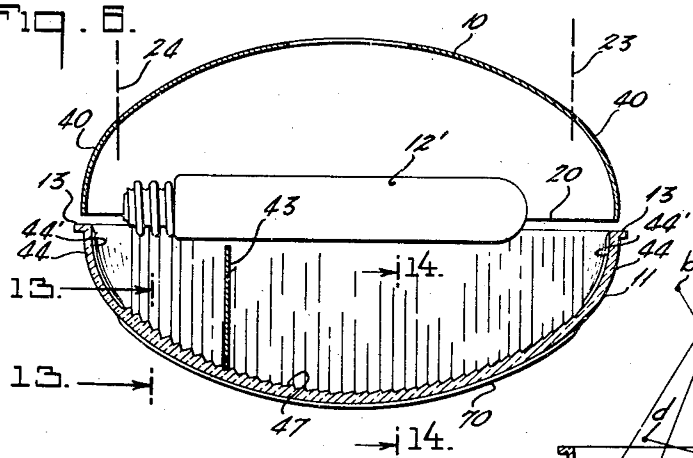


Fig. 6a.

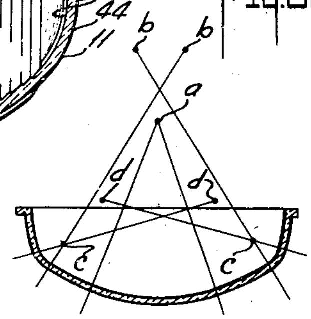
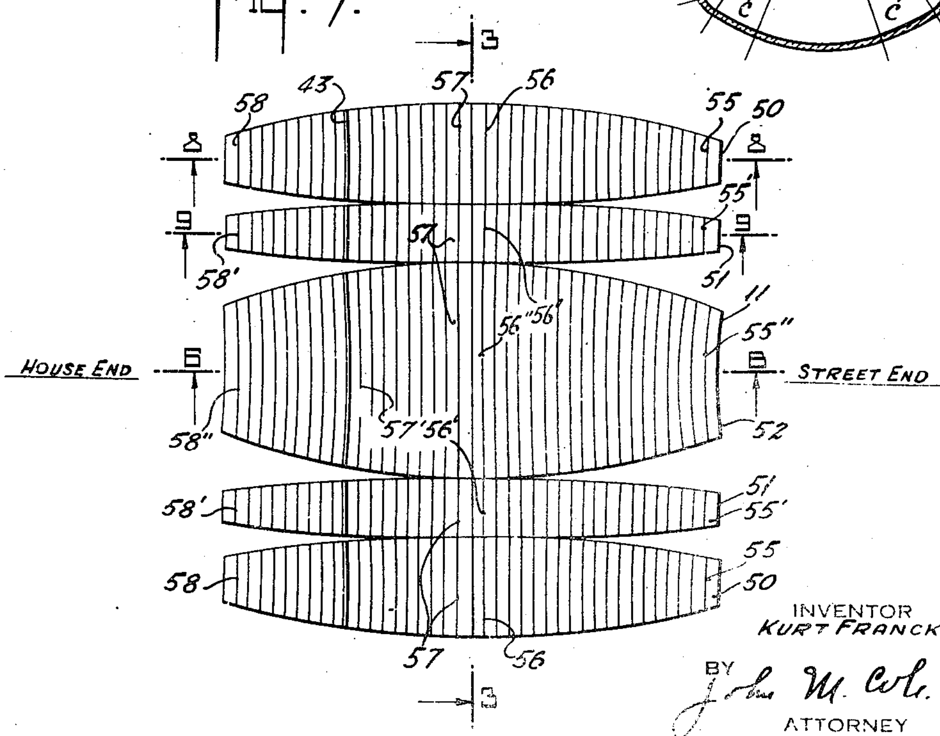


Fig. 7.



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STREET LIGHTING LUMINAIRES AND REFRACTORS THEREFOR

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Fig. 8.

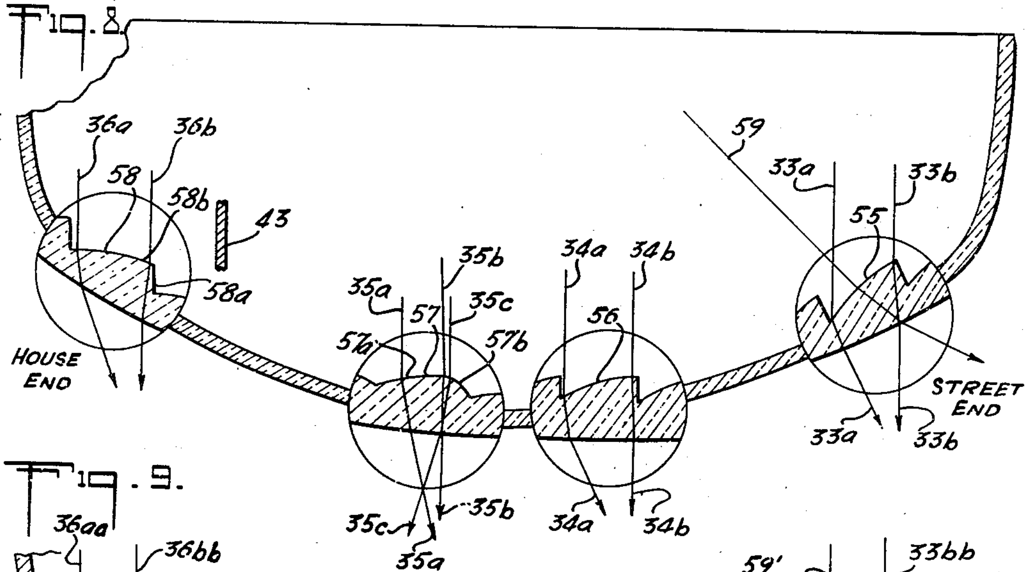


Fig. 9.

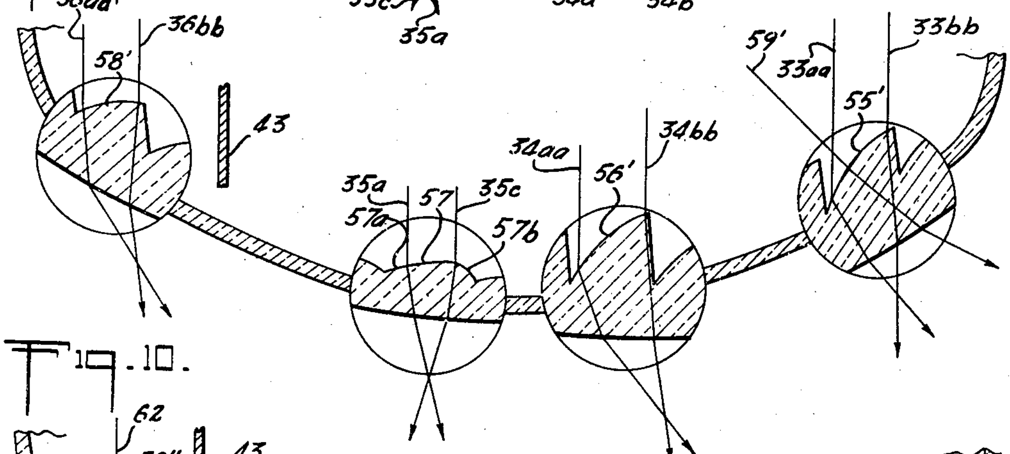


Fig. 10.

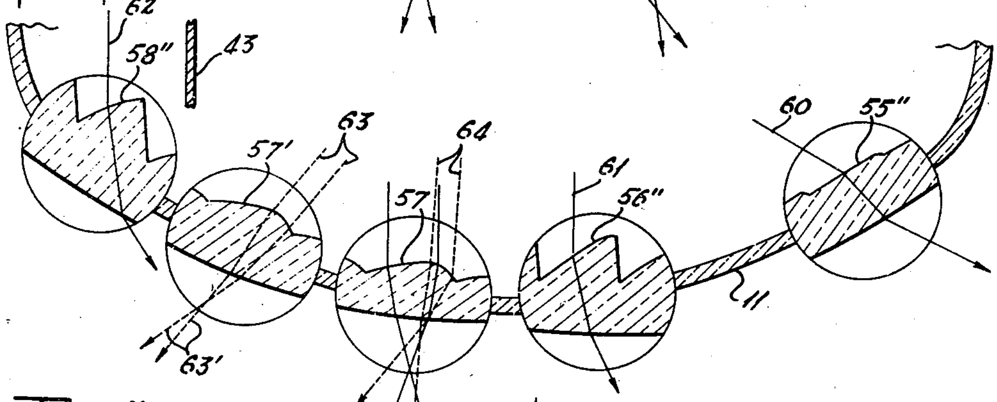


Fig. 11a.

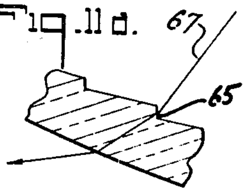
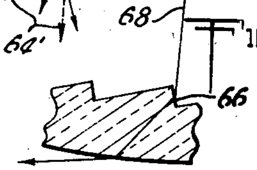


Fig. 11b



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STREET LIGHTING LUMINAIRES AND REFRACTORS THEREFOR

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Fig. 12.

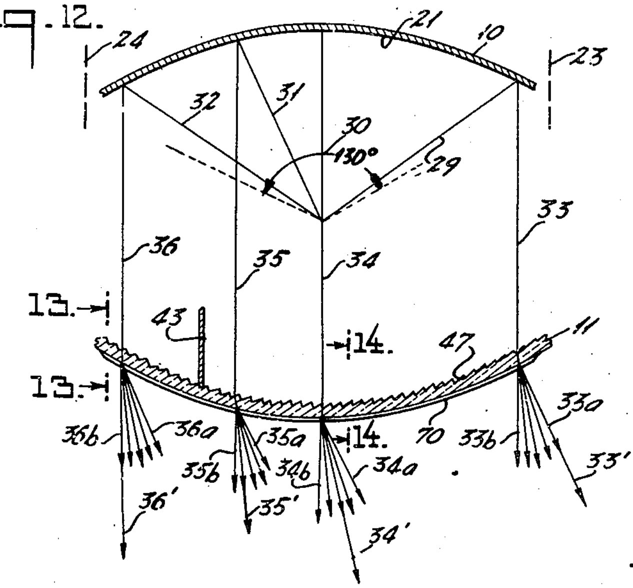


Fig. 13.

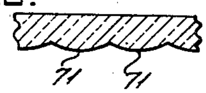


Fig. 14.

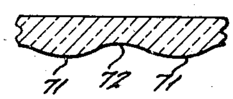


Fig. 15.

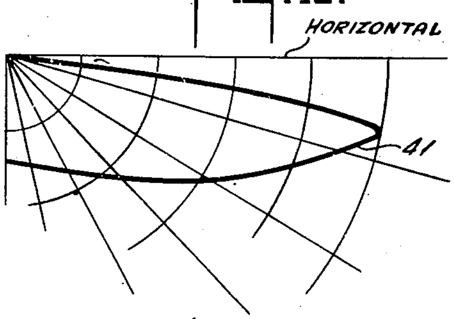


Fig. 17.

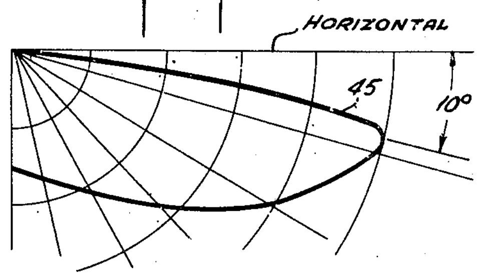


Fig. 16.

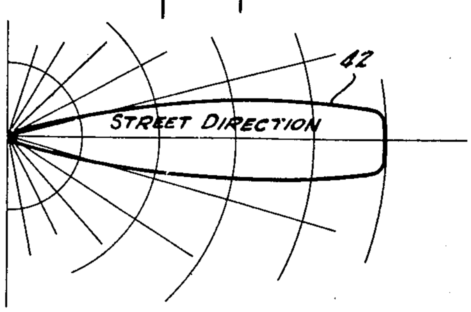
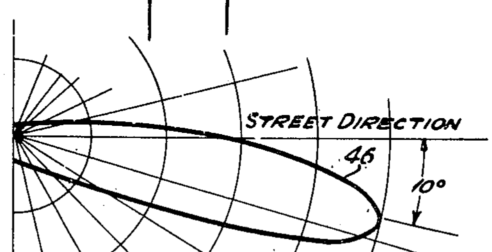


Fig. 18.



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Patented Nov. 1, 1949

2,486,558

UNITED STATES PATENT OFFICE

2,486,558

STREET LIGHTING LUMINAIRE AND REFRACTOR THEREFOR

Kurt Franck, Newark, Ohio, assignor to Holophane Company, Inc., New York, N. Y., a corporation of Delaware

Application August 7, 1947, Serial No. 767,006

30 Claims. (Cl. 240—93)

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The present invention relates to street lighting luminaires and refractors therefor.

Where a luminaire is to be mounted over the approximate center of the street, the beams of light should be projected in opposite directions along the street with the axes of the beams parallel with the curb line, with the maximum candle power of the beam at a sufficiently high angle (say 75°) to illuminate remote street areas. One mode of obtaining asymmetric lateral distributions of such character from a single light source involves the use of downwardly acting reflectors elongated crosswise of the direction of the street. With such reflectors the portion of the light from the source which can be directed onto the remote street areas may be efficiently utilized, the direct light and reflected light too steep to reach such remote areas or at horizontal angles outside the street areas being ineffectual for the major purpose. Where the source is or approaches a point source the lateral spread of the beams may be reduced by making the reflector surfaces concave in horizontal planes.

Owing to the fact that the rays must be reflected across the vertical plane transverse of the street the lateral asymmetry to be obtained from such reflectors alone is limited to beams 180° apart, and hence such equipment is not suited for side of street mounting where it is necessary to have the beams turned in so as to reach the street or road surface.

The present invention contemplates street lighting luminaires suitable for producing the inturned beams required for side of street mounting and utilizing the lateral asymmetry distribution available from a dome shaped reflector of optimum contour.

According to the present invention the light rays reflected from such a reflector as well as the direct rays escaping below the reflector are refracted into directions to produce the inturned beams, to effect diffusion of the rays so that the refractor presents an even over all lighted appearance at all normal viewing angles, and the light rays which would otherwise tend to escape at high angles on the house side of the street are intercepted or are depressed so as to reach the ground near the luminaire.

Other and further objects will hereinafter appear as the description proceeds.

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

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In these drawings:

Figure 1 is a perspective view of the complete luminaire as viewed from the street;

Figure 2 is a diagrammatic view illustrating the mounting of the luminaire at the side of the street;

Figure 3 is a vertical sectional view through the luminaire and illustrating the employment of a pendent incandescent light source and taken in a plane parallel with the curb line, also on the line 3—3 of Figure 4;

Figure 4 is a top plan view of the refractor;

Figure 5 is an end view of the refractor of Figure 4 taken in the direction of the arrow 5;

Figure 6 is a vertical sectional view through the luminaire taken at right angles to the direction of the street, or on the line 6—6 of Figure 3, but showing a horizontal mercury vapor lamp as the light source;

Figure 6*a* is a diagrammatic vertical sectional view to indicate the location of the centers of curves;

Figure 7 is a diagrammatic view illustrating the various zones of the refractor;

Figure 8 is an enlarged sectional view taken on the line 8—8 of Figures 3 and 7;

Figure 9 is a similar section taken on the line 9—9 of Figures 3 and 7;

Figure 10 is a similar section taken on the line 6—6 of Figures 3 and 7;

Figures 11*a* and 11*b* are fragmentary views illustrating for purposes of comparison the action of prisms differing from certain prisms of Figures 8, 9 and 10;

Figure 12 is a view at a smaller scale than Figure 8 illustrating the action of both the reflector and the refractor in plane 8—8 of Figure 3;

Figures 13 and 14 are fragmentary sectional views on the lines 13—13 and 14—14 respectively of Figures 6 and 12; and

Figures 15 to 18 inclusive are photometric curves, Figures 15 and 16 illustrating vertical and lateral performance on one side of the reflector and Figures 17 and 18 illustrating vertical and lateral luminaire performance on one side of the luminaire, these curves being plotted to show the maximum candle power at the same distance from the polar coördinate origin for the curve.

The complete luminaire, an outside view of which is shown in Figure 1, is intended for mounting lateral of the street, as indicated in Figure 2. It is suitable for use with large-size incandescent lamps or with horizontally extending mercury vapor lamps up to 400-watt size. This luminaire has a specular metal reflector 10, a refractor 11 and a light source which may be in the form of a pendent incandescent lamp 12, as shown in Figure 3, or a horizontal mercury vapor lamp 12' as shown in Figure 6. The entire luminaire is mounted from a bracket or post P to be at the desired height above the street surface. The parts are designed so as to provide a complete weather-proof enclosure for the protection of the lamp and the internal reflecting and refracting surfaces. The reflector 10 is intended to handle all the useful light in the upper hemisphere. The refractor 11 intercepts all the downwardly emitted direct light from source as well as the reflected light.

The top of the refractor is flanged as indicated at 13 and is of corresponding contour with the mouth of the reflector and they are held together by suitable fastening devices forming no part of the present invention. As will be apparent from the drawings, both the reflector and refractor have in horizontal planes, a shape which approaches the ellipse and which may conveniently be designated as a quasi-elliptical shape.

The profile of the reflector in a vertical plane lengthwise of the street, is illustrated in Figure 3, while the contour of the reflector in a vertical plane across the street is shown in Figure 6. The sides of the reflector are alike on opposite sides of a longitudinal vertical axis such as 6—6 of Figure 3, so that the light rays are reflected across the reflector.

As shown in Figures 3 and 6 the lower edge 20 of the reflector is substantially at the level of the center of the light source so that direct light rays above the horizontal are intercepted. At each side of the reflector and for a certain distance above its mouth, the profile of the reflector, as indicated in Figure 3, is parabolic with its axis sloping downwardly in the direction of the plane indicated by the section line 8—8. In this region the reflector is also of parabolic contour lengthwise as indicated by the parabolic section 21 shown in Figure 12. The axes of the parabolas forming sections such as 21 are in the plane of Figure 3, i. e., in the direction lengthwise of the street. Thus, each side of the reflector for a distance above its lower edge and between two lines such as indicated at 23 and 24 of Figures 6 and 12, has a contour which is parabolic in two directions at right angles to one another so that each intercepts light in a spherical rectangle. These reflector portions of double parabolic contour act on light in vertical planes as indicated in Figure 3 by the typical rays 25 and 26 to reflect them obliquely downwardly across the longitudinal axis of the luminaire as indicated at 27 and 28. In the longitudinal oblique plane of direct ray 25, for example, the direct rays spread as indicated in Figure 12 by the rays 29, 30, 31, 32. Inasmuch as these rays strike a parabolic surface they are reflected parallel to one another and to the direction of the street as indicated by the rays 33, 34, 35, 36. It is thus apparent that the reflector produces two beams of rectangular cross-section, each directed below the edge of the reflector at angles such as 75° above the nadir and suitable for lighting the remote street areas as indicated at the left of Figure 3. The vertical angular extent of the parabolic portion of the reflector profile may extend through about 30° vertically and about 130° horizontally so that a very large portion of the light flux in the upper hemisphere is collected and directed toward the remote street areas.

Above this double parabolic region of the reflector, i. e., above the lines 37 of Figure 3, the reflector converges inwardly more rapidly than the lower parabolic portion so that rays such as 38, 39 of Figure 3 are reflected more steeply so as to be directed toward nearer street areas. In longitudinal directions above the lines 37 of Figure 3, the reflector shape is a continuation of the longitudinal parabolic contour so that while the rays 38, 39 are reflected into steeper angles in planes longitudinal of the luminaire, they continue to be reflected like rays 33 to 36 inclusive in generally parallel directions.

At the street and house end of the reflector i. e., the portions beyond the lines 23 and 24 of Figure 6, the reflector is provided with an inwardly concave contour such as illustrated at 40—40 so as to close off the ends of the reflector and prevent the escape of light upwardly in such directions. This provides a reflector whose lower edge 20 is a closed curve in a horizontal plane and this curve approximates the shape of an ellipse with its prolate axis transverse of the street direction.

The output of the reflector is illustrated by the typical curves 41—42 of Figures 15 and 16 from which it will be seen that the maximum beam candle power is about 10° below the horizontal, and that in the plane of maximum candle power, the beam has a narrow spread in the direction of the street.

The refracting bowl 11 has the same quasi-elliptical contour as the mouth of the reflector and is adapted to intercept all the light reflected downwardly by the reflector as well as the downwardly directed direct light from the source. It carries an internal shield 43 which intercepts direct light which would otherwise fall on the "house" end.

Inasmuch as the making of molds suitable for pressing refractors is facilitated by employing curves which are parts of circles, the present refractor is designed to have all component parts of its contour composed of circular arcs. In transverse planes such as in Figure 3, the inner surface of the refractor is of substantially semicircular contour with the loci of the centers in the horizontal line extending lengthwise of the unit and passing through the light center. The maximum radius in such directions is at the center of the refractor, i. e., at the line 3—3 of Figure 4. The radii of the circles decrease in each direction toward the ends of the refractor at a rate corresponding with the narrowing of the mouth of the reflector. The general profile of the outer surface of the refractor is concentric with the inner surface.

In the longitudinal median plane of Figure 6a the centers of curvature for the outer surfaces of the refractor are indicated by the points *a*, *b*, *b*, *c*, *c*, *d*, *d*, the curve formed by the arcs struck from centers *a* and *b* closely approximating an elliptical arc. This elliptical longitudinal section is continued up to the side portions of the flange 13 so that all the parallel light rays sent across the reflector axis fall on this quasi-elliptical portion of the refractor. Relatively steep end walls 44—44 of the refracting bowl are formed by curves struck from centers *c* and *d*. They are under the ends of the reflector and serve to close off the ends of the bowl. They carry rather deep diffusing flutes 44'.

The purpose of the refractor is to control the lateral symmetric light distribution typically shown in Figure 16 so as to provide a lateral asymmetric pattern suitable for side of street mounting as indicated by the curves **45** and **46** of Figures 17 and 18. The maximum beam in the example given is about 10° from the street direction and 10° below the horizontal.

To accomplish a lateral deviation of the light, the entire surface of the bowl on which the rays parallel with the street direction fall is provided with lateral refracting prisms, all of the same sign as indicated at **47** in Figures 4, 6 and 12. They are here shown as interiorly disposed and are in the form of annular lenticulations concentric about the horizontal axis through the light source.

To get the proper flux distribution on the street these prisms are laid out in accordance with the following system: As each point of the glass, and therefore, each lenticular element receives light both from the reflector and directly from the light source, it is important to weigh the two impinging rays at each point and in the prism design favor one or the other. To obtain proper distribution on the street, it has been found that the annular prisms should be arranged in several tiers as shown in Figures 3 and 7; the top tiers handling most of the high angle light from the reflector being in the region **50**, the intermediate tiers handling less reflected light and more directed light are in the region **51**, while the lower tier prisms, dealing mostly with direct light, are in the bottom of the bowl as indicated at **52**. Balancing reflected light versus light direct from the source, it has been found that the top tier should be designed to deal with the reflected light only while the bottom tier should be designed mainly for direct light and the intermediate tiers should serve as transition zones between top and bottom tiers.

Reference to Figure 2 shows that in order to cover the width of the street surface S at the distance at which the maximum beam reaches it, the beam should spread between lines **53** and **54**. Line **53** is parallel with the curb line so that the light which is to be sent out along the curb need not be deviated from the directions provided by the reflector. The dominant purpose of the prisms **47** is to deviate light across the street, and in Figure 12 this dominant action is indicated by rays **33'**, **34'**, **35'** and **36'**. Such a system of prisms would provide suitable light distributions on the roadway, but an undesirable appearance to users of the roadway. To one viewing the luminaire in the direction **54**, only the extreme right end of the refractor would appear lighted up because only this portion would send light in that direction. One viewing the refractor in the direction **53** would get light only from the extreme left end. In any case with such prisms, one end only of the refractor would be lighted and the remainder would be dark.

To overcome the uneven brightness appearance of the refractor the prism surfaces are specially contoured as shown more particularly in Figure 8, illustrating the contour of the lenticular elements in the upper tier, Figure 9, illustrating the contour of the elements in the intermediate tier and Figure 10 illustrating the contour in the lower tier.

At the right of Figure 8 rays such as **33a**, **33b**, **34a**, and **34b** illustrate the high angle rays directed by the reflector on to prisms **55** and **56** located as indicated in Figure 7. The incident surfaces of these prisms are convexly curved in radial planes so that each prism has a portion substantially

parallel with the opposed outer surface and a portion at a substantial angle to the outer surface. Hence rays such as **33b** and **34b** are not deviated toward the street while rays **33a** and **33b** have a maximum deviation. In this region the direct light such as ray **59** falls on the active surfaces of these prisms and is refracted toward and across the street and scattered at high angles above the horizontal so as to cause no undesired brightness.

At the house end of the refractor a different control is required in order to avoid undesirable brightnesses. In the region between the median plane **33** and the light intercepting shield **43**, the lenticular areas such as **57** have convex surfaces **57a** to the left or on the house end with a refracting power and deviation similar to the prisms **55** and **56** for the purpose of spreading the dominant portion of rays such as **35** into the same general direction as the rays from prisms **55** and **56**. This is illustrated by rays **35a** and **35b**. The right hand portion **57b** of prism **57** is preferably convex so that rays such as **35c** are refracted toward the house end of the refractor. In these asymmetric flutes between median plane **3—3** and the shield **43**, about ⅔ of the light is refracted into the main beam and ⅓ of it sent backward.

In the upper tier at the extreme house end of the refractor, i. e., beyond the shield **43**, the prisms **58** have vertical risers **58a** and convex surfaces **58b**. The latter act on rays **36a** and **36b** as indicated. The cumulative effect of the deviation introduced into the dominant beam by prisms **55**, **56**, **57** and **58** is such that from the entire opposed surface of the refractor light is sent out in moderately divergent directions as indicated by the rays in the lower part of Figure 12.

The prisms of the intermediate tier are shown in Figure 9. Prisms **55'**, **56'** and **58'** are similar to prisms **55**, **56** and **58**, but have greater refracting power as indicated by the greater deviation of the rays toward the right. The rays are indicated by the same numerals with a double subscript. With the greater refracting power the laterally refracted rays at lower vertical angles spread across the nearer street surfaces. The outline of the asymmetric prism **57** is continued through the intermediate tier and the same reference characters applied. Direct light such as **59'** is refracted more than the higher direct ray **59**.

As shown in Figure 10, the lower portion of the refractor has prisms **55''** and **56''** with straight or comparatively straight active surfaces as they act principally on radial rays such as **60** and **61**. The prisms **58''** receive only reflected light and have a convex face of greater refracting power than **58** or **58'** so as to direct the rays further from the curb. The asymmetric prism **57** is continued as indicated. Two such asymmetric prisms **57** and **57'** are indicated in Figure 10. They receive more direct light in the lower part of the refractor and some of this direct light indicated by dotted lines **63** and **64**, falls on the convex risers of the prisms. This light is refracted and diffusively transmitted as indicated by the dotted lines **63'**, **64'** and is at lower angles than would be the case if the prisms had abrupt risers. For purposes of comparison, vertical risers are indicated at **65** and **66** in Figures 11a and 11b. Rays **67** and **68** of the same original direction as rays **63** and **64** are at such angles of incidence to these risers as to be emitted at very high angles from the house end of the refractor. These ray paths are indicated in Figures 11a and 11b and inasmuch as these rays would be at comparatively acute angles with the longitudinal axis of the refractor bowl, they tend to build up high brightness in this direction. The purpose of the less abrupt risers 57*a* of the prisms 57 is to lower and scatter such light emitted from the house end of the unit.

Viewing the refractor with this prismatic system from any direction within the limits of lateral spread 53—54, the entire refractor looks lighted up because each prism sends some amount of light into the viewing direction. This system, therefore, while retaining the necessary candlepower values, decreases the spot brightness of the luminaire by distributing it over its entire surface. With the high wattage lamps for which this luminaire is designed, this is an important consideration from the standpoint of decreasing glare and producing visual comfort.

Vertical deviation is obtained by a pattern 70 of diffusing flutes which cover the outer surface of the refractor opposite the annular prisms. At the ends of the fluted surface the flutes are as shown at 71 in Figure 13 relatively closely spaced convex flutes. As the flutes are radial, as viewed in Figure 5 and are of uniform width, they diverge toward the center of the refractor and as indicated in Figure 14 are spaced wide apart sufficiently to provide room for concave flutes 72 of the same deviation characteristic as the convex flutes. These concave flutes have tapering width. The over all effect of the concave and convex flutes is to produce the same deviation characteristics and the same vertical diffusion over the entire length of the fluted area. The operation of these diffusing flutes is independent of the operation of the lateral refracting lenticular elements so that the flutes would be effective on the bowl of generally the same shape where lateral asymmetry is not involved.

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. In a street lighting luminaire adapted for side of street mounting, in combination, a light source, a specular reflector of parabolic contour in two planes at right angles to one another and whose intersection passes through the light source and adapted to intercept direct light in a spherical rectangle and reflect it in a beam of parallel light rays of rectangular beam cross-section parallel with the direction of the street, and a refractor intercepting said reflected rays, the refractor having lenticular elements parallel with one side of the rectangular area defining the reflected beam and with the street direction, the lenticular elements being of uniform refracting power throughout their respective lengths so as to transmit light without deviation in directions parallel to their length, the lenticular elements being all of the same sign for deviating the beam in a direction lateral of the lengthwise direction of the prisms and toward the street area, each element having a varying refracting power across its face so that each lenticular element acts to spread the refracted light which it transmits into the deviated beam, the successive lenticular elements being tilted in variable amounts such that the spreading rays from all the elements overlap in the deviated beam in uniform angular amounts.

2. The combination of claim 1, wherein transversely of the lenticular elements the refractor has a smooth external contour and an internal profile of regressed prismatic shape.

3. The combination of claim 1, wherein transversely of the lenticular elements the refractor has a smooth external contour and an internal profile of regressed prismatic shape, the lenticular elements having convex surfaces.

4. The combination of claim 1, wherein transversely of the lenticular elements the refractor has a smooth external contour and an internal profile of regressed prismatic shape, the lenticular elements having convex surfaces, the active surfaces of the lenticular elements to the street side of the median plane acting to refract direct light received thereon to scatter it at wide angles laterally of the street side of the main beam, the lenticular elements in a region to the other or house side of said median plane and within a predetermined angle from said plane having convex risers acting to refract direct light received thereon to scatter it at less wide angles laterally of the other or house side of the main beam.

5. The combination of claim 1, wherein transversely of the lenticular elements the refractor has a smooth external contour and an internal profile of regressed prismatic shape, the lenticular elements having convex surfaces, the active surfaces of the lenticular elements to the street side of the median plane acting to refract direct light received thereon to scatter it at wide angles laterally of the street side of the main beam, the lenticular elements in a region to the other or house side of said median plane and within a predetermined angle from said plane having convex risers acting to refract direct light received thereon to scatter it at less wide angles laterally of the other or house side of the main beam, and having an opaque screen parallel with the lenticular elements and disposed beyond said region for intercepting direct light so that such light does not reach the lenticular elements beyond it.

6. In a street lighting luminaire adapted for side of street mounting in combination, a light source, a specular reflector symmetrical on opposite sides of a vertical longitudinal plane through the source and at right angles to the direction of the street, and having zones extending upwardly from the horizontal, the reflector being of parabolic contour in transverse vertical planes and also in planes at right angles to the transverse planes passing through the light source and adapted to reflect the intercepted light in two beams of parallel light rays of rectangular beam cross-section parallel with the direction of the street, and below the opposite sides of the reflector, and a refractor intercepting said reflected rays, the refractor having laterally refracting vertical lenticular elements, arcuate about a horizontal axis in the longitudinal plane of the reflector and of uniform refracting power throughout their respective lengths so as to transmit light without substantial vertical deviation in transverse planes, the lenticular elements being all of the same sign for deviating the beams in directions lateral of the transverse plane of the reflector and toward the street areas, each element having a varying refracting power across its face so that each lenticular element acts to spread the refracted light which it transmits into the deviated beam, the successive lenticular elements being tilted in variable amounts such that the spreading rays from all of the elements overlap in the deviated beam in uniform angular amounts.

7. The combination of claim 6, wherein the reflector above the zones of double parabolic contour has zones generally parabolic longitudinally and extending part way to zenith of less steep vertical profile to reflect light more steeply, and the refractor has zones below the first-mentioned zones provided with lenticular elements which are continuations of the first-mentioned lenticular elements.

8. The combination of claim 6, wherein transversely of the lenticular elements the refractor has a smooth external contour and an internal profile of regressed prismatic shape, the lenticular elements having convex surfaces, the lenticular elements to the street side of the median plane having risers facing the source and generally parallel with the reflected rays and acting to refract direct light received thereon to scatter it at wide angles laterally of the street side of the main beam, the lenticular elements in a region to the other or house side of said median plane and within a predetermined angle from said plane having convex risers acting to refract direct light received thereon to scatter it at less wide angles laterally of the other or house side of the main beam.

9. In a street lighting luminaire adapted for side of street mounting in combination, a light source, a specular reflector intercepting direct light in a zone extending upwardly from the horizontal plane through the source, the reflector being symmetrical on opposite sides of a longitudinal vertical plane at right angles to the direction of the street and through the source and of parabolic contour in transverse vertical planes through said zone and also parabolic in oblique longitudinal planes passing through the light source and adapted to reflect direct light intercepted thereby in said zones in two beams of parallel light rays of rectangular beam cross-section and parallel with the direction of the street directed immediately below the opposite sides of the reflector, and a refractor having upper zones below the plane through the source and intercepting said reflected rays, the refractor having laterally refracting vertical lenticular elements extending downwardly from the horizontal plane through the source and arcuate about a horizontal axis through the source and in the longitudinal plane of the reflector and of uniform refracting power throughout their respective lengths in said zones so as to transmit light without substantial vertical deviation in transverse planes, the lenticular elements being all of the same sign for deviating the beam in a direction lateral of the transverse plane of the reflector and toward the street area, each element having a varying refracting power across its face so that each lenticular element acts to spread the refracted light which it transmits into the deviated beam, the successive lenticular elements being tilted in variable amounts such that the spreading rays from all the elements overlap in the deviated beam in uniform angular amounts.

10. The combination of claim 9, wherein transversely of the lenticular elements the refractor has a smooth external contour and an internal profile of regressed prismatic shape, the lenticular elements having convex surfaces.

11. The combination of claim 9, wherein transversely of the lenticular elements the refractor has a smooth external contour and an internal profile of regressed prismatic shape, the lenticular elements having convex surfaces, the active surfaces of the lenticular elements to the street side of the median plane acting to refract direct light received thereby to scatter it at wide angles laterally of the street side of the main beam, the lenticular elements in a region to the other or house side of said median plane and within a predetermined angle from said plane having convex risers acting to refract direct light received thereby to scatter it at less wide angles laterally of the other or house side of the main beam.

12. The combination of claim 9, wherein transversely of the lenticular elements the refractor has a smooth external contour and an internal profile of regressed prismatic shape, the lenticular elements having convex surfaces, the active surfaces of the lenticular elements to the street side of the median plane acting to refract direct light received thereby to scatter it at wide angles laterally of the street side of the main beam, the lenticular elements in a region to the other or house side of said median plane and within a predetermined angle from said plane having convex risers acting to refract direct light received thereby to scatter it at less wide angles laterally of the other or house side of the main beam, and having an opaque screen parallel with the lenticular elements and disposed beyond said region for intercepting direct light so that such light does not reach the lenticular elements beyond it.

13. In a street lighting luminaire adapted for side of street mounting, in combination, a light source, a specular reflector symmetrical on opposite sides of a vertical longitudinal plane through the source and at right angles to the direction of the street and having zones extending upwardly from the horizontal, the reflector being of parabolic contour in transverse vertical planes and also in planes at right angles to the transverse planes passing through the light source and adapted to reflect the intercepted light in two beams of parallel light rays of rectangular beam cross-section parallel with the direction of the street and below the opposite side of the reflector, the reflector having inwardly concave end portions interconnecting the side portions to provide a generally elliptically shaped mouth at its bottom, and a refracting bowl immediately below the reflector and of the same size and shape at the mouth of the reflector, the bowl being of semi-circular cross-section with respect to a horizontal axis through the source, the bowl having annular laterally refracting prisms of the same sign intercepting the parallel reflected rays and laterally refracting and transmitting them into inturned beams directed toward the street areas without substantially changing the vertical angle of the rays in transverse planes.

14. The combination claimed in claim 13, wherein the street end of the refractor is divided into upper side zones, intermediate side zones and a central lower zone, and the prisms in the upper zones have less refracting power than those in the intermediate zones and more than those in the lower zone to variably deviate the direct and reflected light.

15. The combination claimed in claim 13, wherein the refracting prisms on the near end of the refractor away from the street have sloped risers presenting reduced angles of incidence to direct light whereby such light is deviated less than it would have been by abrupt risers.

16. The combination claimed in claim 13, wherein the prisms on the remote end of the refractor away from the street have abrupt risers, and having a screen intercepting direct light emitted toward said risers.

17. A refracting bowl of semi-circular cross-

section in vertical transverse planes and with respect to a horizontal axis, the radii of the circles decreasing from a central transverse plane toward the ends at such a rate as to provide a surface convex in both directions, the refractor having annular lenticular elements all of the same sign and having convex light receiving surfaces for intercepting light rays in planes normal to the horizontal axis and crossing the vertical longitudinal plane and laterally refracting and transmitting them in diffused beams oblique to the vertical longitudinal plane.

18. A refracting bowl of semi-circular cross-section in vertical transverse planes and with respect to a horizontal axis, the radii of the circles decreasing from a central transverse plane toward the ends at such a rate as to provide a surface convex in both directions, the refractor having interiorly disposed annular lenticular elements all of the same sign and having convex light receiving surfaces for intercepting light rays in planes normal to the horizontal axis and crossing the vertical longitudinal plane and laterally refracting and transmitting them in diffused beams oblique to the vertical longitudinal plane, the refractor having exteriorly disposed light diffusing flutes transverse of the lenticular elements.

19. A light transmitting bowl of the contour of a prolate quasi-ellipsoid of revolution and provided on its outer surface with convex diffusing flutes of uniform width extending lengthwise of the bowl and radial with respect to the axis of revolution, and concave flutes of tapering width between the convex flutes.

20. A refracting bowl having a substantially smooth external profile generated by the rotation through substantially 180° about a horizontal axis of a curve of quasi-elliptical shape with the horizontal axis and its major axis coinciding, and an internal surface of annular contour about said horizontal axis and of regressed prismatic contour longitudinally, the prisms being all of the same sign to act on rays incident thereon in directions normal to said horizontal axis and divert them into two inturned beams at less than 180° to one another, the prism surfaces in longitudinal planes being convex with a portion of each such surface substantially parallel to the opposed area of the outer surface so that a portion of said light falling on each prism is transmitted without deviation.

21. A refracting bowl as claimed in claim 18, wherein the refractor has a "street" end extending from its transverse plane toward which the inturned beams are bent, and a "house" end on the opposite side of the said transverse plane, and the house end has a zone near said plane and an outer zone and has upper side zones, intermediate side zones and bottom zones, all of which extend from one end to the other end, and wherein all the prisms in the three latter mentioned zones and in the zone near the transverse median plane have convex risers adapted to depress light rays incident thereon in directions radial from the center of the quasi-ellipse.

22. A street lighting luminaire for side of street mounting, comprising a light source, a downwardly opening specular reflector of quasi-elliptical shape in horizontal planes with its long axis at right angles to the direction of the street and intercepting the upper hemisphere of light from the source, the reflector having along the sides thereof a parabolic contour in transverse vertical planes which reflects light below the opposite side of the reflector at substantially uniform angles below the horizontal, the sides of the reflector being of substantially parabolic contour on each side of the short axis to reflect the rays generally parallel with said vertical plane of the short axis whereby the reflected light is symmetrically concentrated into the general direction of the transverse median plane and the dominant reflected light is in beams 180° apart and below the horizontal, and a refractor bowl of the contour of a prolate, quasi-ellipsoid of revolution about a horizontal axis through the center of the light source and of the same size as the mouth of the reflector, placed below the reflector and intercepting the reflected light and the direct light in the lower hemisphere, the bowl having semi-circular refracting prisms about the axis of revolution disposed opposite the parabolic sides of the reflector to laterally deviate direct light and reflected light from both sides of the reflector toward the street end of the luminaire and directing the dominant emitted light in beams less than 180° apart and below the horizontal for illuminating remote areas of the street alongside which the luminaire is mounted.

23. A street lighting luminaire as claimed in claim 22, wherein the refractor is externally smooth in longitudinal radial planes, and the prisms are internally disposed and of variable profile.

24. A street lighting luminaire as claimed in claim 22, wherein the prisms have variable convex profiles on the incident face to effect a variable deviation of the light and diffuse it across the street width.

25. A street lighting luminaire as claimed in claim 22, wherein a small portion of the inner surface of each prism is parallel with the opposed outer surface to effect no lateral deviation and the remaining portions of all the prisms are convexly curved to present increasing angles of incidence whereby the deviation is increased and the rays from each prism after crossing the undeviated rays therefrom are spread away from the same.

26. A street lighting luminaire as claimed in claim 22, wherein all the prisms have convex profiles on the incident side to effect a variable deviation of the light and diffuse it across the street width and the prisms on the end of the refractor remote from the street and adjacent said vertical plane have sloping risers.

27. A street lighting luminaire as claimed in claim 22, wherein the external surface of the refractor is provided with longitudinally extending flutes disposed in radial planes about the longitudinal horizontal axis through the light source to effect vertical diffusion of the emitted light.

28. A street lighting luminaire as claimed in claim 22, wherein the prisms have variable convex profiles on the incident face to effect a variable deviation of the light and diffuse it across the street width, and wherein the external surface of the refractor is provided with longitudinally extending flutes disposed in radial planes about the longitudinal horizontal axis through the light source to effect vertical diffusion of the emitted light.

29. A street lighting luminaire as claimed in claim 22, wherein a small portion of the inner surface of each prism is parallel with the opposed outer surface to effect no lateral deviation and the remaining portions of all the prisms are convexly curved to present increasing angles of

incidence whereby the deviation is increased and the rays from each prism after crossing the undeviated rays therefrom are spread away from the same, and wherein the external surface of the refractor is provided with longitudinally extending flutes disposed in radial planes about the longitudinal horizontal axis through the light source to effect vertical diffusion of the emitted light.

30. A street lighting luminaire as claimed in claim 22, wherein the prisms have variable profiles on the incident face, these prisms on the street end of the transverse median plane in the lower region of the refractor which receives dominantly direct light having decreasing refracting power the greater the distance from said plane.

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