OVATE ROADWAY REFLECTOR

Filed Oct. 6, 1948

Fig.1.

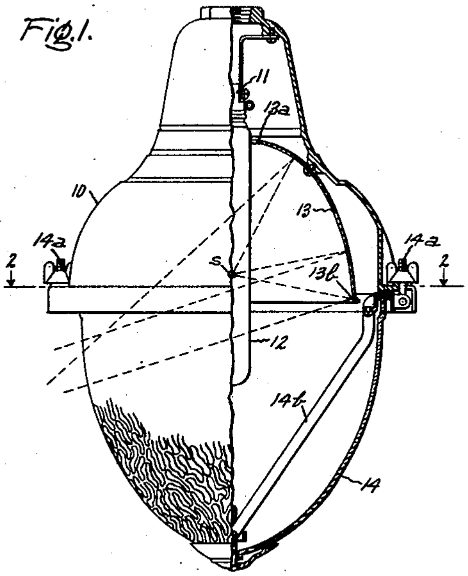


Fig.2a

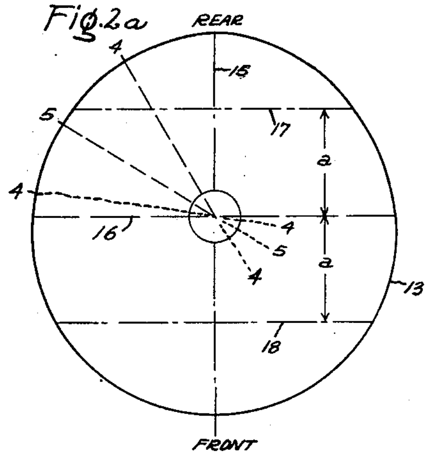


Fig.2b.

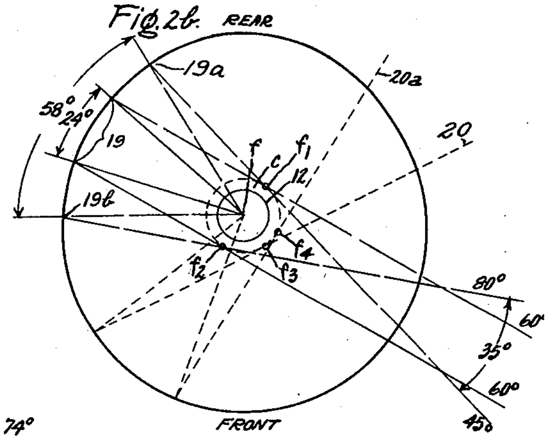


Fig.5.

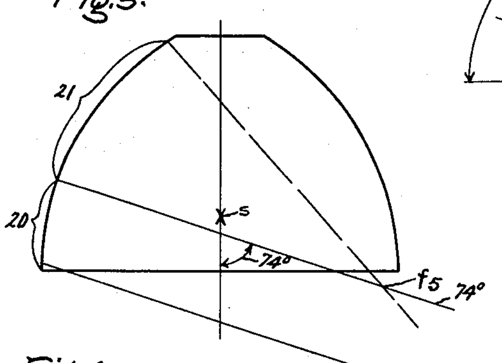


Fig.3.

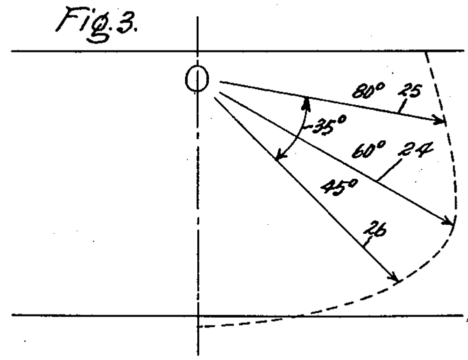
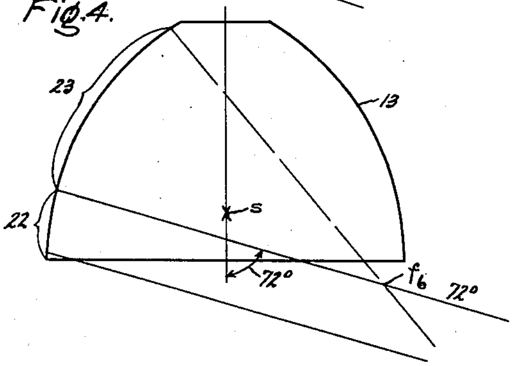


Fig.4.



Inventor:
Charles H. Rex,
by Claude H. Mott.
His Attorney.

Patented June 3, 1952 2,599,285

UNITED STATES PATENT OFFICE

2,599,285

OVATE ROADWAY REFLECTOR

Charles H. Rex, Marblehead, Mass., assignor to General Electric Company, a corporation of New York

Application October 6, 1948, Serial No. 53,120

7 Claims. (Cl. 240—25)

1

My invention relates to luminaires, and more particularly to street or roadway luminaires including reflectors.

In street or highway luminaires arranged for mounting at one side of the roadway, it is desirable that the amount of reflected light directed upon the remote side of the roadway be appreciably greater than that directed upon the adjacent side. The reason for this is that objects upon the roadway are discerned from a distance mainly by silhouetting against the light reflected from the roadway surface. Since the light reflected from the roadway surface upon the remote side of the roadway is directed more obliquely to a driver's line of vision along the roadway than is the light reflected from the adjacent side of the roadway, it is necessary that a greater amount of reflected light fall upon the remote side in order to give a comparable silhouetting effect.

The direction of a relatively great amount of light upon the remote side of the roadway from a side-mounted luminaire is sometimes sought to be accomplished by the use of a circular or conoidal reflector provided with one or more deflectors to redirect the light from the main reflector and lamp into two main asymmetric beams obliquely directed up and down the roadway in opposite directions along the roadway. Each such secondary reflection, however, results in a loss of efficiency, while the use of a circular reflector further decreases the efficiency by redirecting directly reflected light through the light source.

Accordingly, therefore, it is a general object of my invention to provide a new and improved street or roadway lighting luminaire.

It is a further object of my invention to provide a new and improved ovate reflector arranged to direct light mainly up and down the roadway in discrete asymmetric beams disposed at a high angle with respect to the vertical to the nadir.

It is still another object of my invention to provide a new and improved open ovate roadway reflector having a horizontal configuration shaped to direct reflected light around the light source in a substantially symmetrical clearance region.

It is a still further object of my invention to provide a new and improved ovate reflector having a horizontal configuration arranged to define a pair of oppositely and asymmetrically directed beams and to direct substantially all reflected light through a conical clearance region radially spaced from the vertical through the light center.

For a more complete understanding of my invention and a further appreciation of its various objects and advantages, reference may now be had to the following detailed specification, taken in conjunction with the accompanying drawing, in which Fig. 1 is a side elevation, partially in cross-section, of a luminaire embodying my invention; Figs. 2*a* and 2*b* are identical cross-sectional views of the luminaire reflector in the plane of the reflector rim, taken along the line 2—2 of Fig. 1, the two figures being used to illustrate diagrammatically different characteristics of the reflector; Fig. 3 is a partial light distribution diagram looking vertically down upon a roadway; and Figs. 4 and 5 are vertical cross-sectional views of the reflector taken along the lines 4—4 and 5—5, respectively, of Fig. 2*a*.

2

Referring now to the drawing, the luminaire there shown by way of illustration of one embodiment of my invention, comprises an integral mounting hood and reflector casing **10** having mounted therein a socket **11** for a light source, such as an elongated gaseous discharge lamp **12**, and arranged removably to support an ovate reflector **13** having a circular upper opening **13***a* and a lower rim portion **13***b*. A transparent or translucent globe **14**, which may suitably be formed of diffusing glass, is removably connected to the rim of the casing **10** by bolts **14***a* and brackets **14***b*. The discharge lamp **12** is vertically mounted and so positioned that its effective light center is located slightly above the plane of the reflector rim and on a vertical line passing through the intersection of the major and minor reflector axes in the plane of the rim. It will of course be understood that, if desired, an incandescent lamp may be used. The spacing of the effective light center above the reflector rim is determined by the dimensions of the reflector and the desired vertical angles of cut-off for direct illumination along and across the roadway. Preferably, this angle of cut-off of light projected directly from the source is between 72 and 76 degrees above the vertical to the nadir.

The cross-sectional view shown at Fig. 1 is taken in the major plane of symmetry, or major plane of the reflector. By "major plane" is meant the plane through the major axis **15** and perpendicular to the plane of the rim. As further explained below, the reflector **13** is particularly designed for disposition at one side of a roadway with the plane of symmetry disposed perpendicularly across the roadway and at right angles to the roadway surface.

In the embodiment of the invention shown in the drawings the effective light center *s* is shown coincident with the point of intersection of the major and minor reflector axes in the horizontal plane through the light center *s*. If desired, and indeed by preference, the effective light center *s* is slightly eccentric and is positioned on the major axis slightly to the rear of the point of intersection of the axes. In Fig. 1, such positioning can be accomplished by mounting the reflector **13** with its circular upper opening **13***a* eccentric with respect to the lamp **12**. Such eccentric positioning puts a greater amount of light on the roadway surface.

The ovate shape of the reflector **13** is illustrated by its cross-sectional configuration in the plane of the rim as shown at Fig. 2*a*. From this figure, it is evident that the reflector is only slightly ovate, and to this end, the length ratio of the minor axis **16** to the major axis **15** in the plane of the rim is at least 4/5. The ovate shape is further characterized by the fact that cords **17** and **18**, taken at equal predetermined distances *a* from the minor axis **16** and parallel thereto are of unequal length, the cord **17** on the rear or house side of the reflector being somewhat shorter than the cord **18** on the front side of the reflector.

The cross-sectional configuration of the reflector in the plane of the rim and in planes parallel thereto is decreasingly ovate from the rim toward the circular upper opening **13***a*. This ovate shape is designed to accomplish two principal functions; first, to define two discrete main beams of light directed asymmetrically up and down the roadway in opposite directions; and second, to direct light reflected from substantially all points horizontally around the reflector through a clearance region radially spaced away from a vertical line passing through the effective light center *s*. Fig. 2*b* illustrates the manner in which both these desirable functions are accomplished. Usually the clearance region is outside the lamp envelope when a gaseous discharge lamp is used, but when an incandescent lamp is used the clearance region may pass through the glass bulb, it being sufficient that the incandescent filament is spaced from the clearance region.

Referring now more particularly to the sectional view Fig. 2*b*, it will be noted that the reflector illustrated is symmetrical on opposite sides of the major plane. Each rear quadrant of the reflector includes a portion **19** which is parabolic in horizontal cross-section and has its focus at *f*, the point of intersection of the major and minor reflector axes in the plane of the section. The parabolic portion **19** may suitably subtend an angle of about 24 degrees and have its axis disposed at an angle of about 60 degrees with the major axis **15**, as shown. This parabolic portion of the rear quadrant therefore projects a discrete beam of parallel light rays between the lines marked "60°." The corresponding parabolic portion of the other rear quadrant projects a similar beam of parallel rays in the opposite direction along the roadway.

Apart from the parabolic portions **19**, the cross-sectional configuration of the reflector in the plane of the rim is a composite curve formed of a plurality of adjacent elliptical portions, each of which has a primary focus at *f* and a secondary focus lying in an annular clearance area *c* which is radially spaced from the primary focus *f*. The reflection of light from elliptical portions of the rear quadrant at two points **19***a* and **19***b* on opposite sides of the parabolic portion **19** is indicated by the lines marked "45°" and "80°" respectively, at Fig. 2*b*. These two points are chosen to subtend an angle of 58 degrees of direct light from the center of the source at *f*, with one such point on the minor axis **16** and the portion **19** approximately centrally between the points. It will be noted that all the light falling on this portion of the rear quadrant directly from the source and within the arc of 58 degrees is redirected into a reflected beam subtending an angle of only 35 degrees with the source as a center, i. e., between 45 degrees and 80 degrees, measured from the primary focus *f*. Thus, a large amount of light is collected in the rear quadrant and reflected into a relatively narrow beam generally along the line from the parallel beam from the parabolic portion **19**. The result is that an intense main beam of reflected light is directed obliquely up the roadway in one direction. A similar intense beam is collected through a 58 degree angle, or other suitable collecting angle, of the other rear quadrant and directed obliquely down the roadway in the opposite direction. The secondary foci of the light rays reflected from the points **19***a* and **19***b* of the rear quadrant are shown at f_1 and f_2, respectively, at Fig. 2*b*. These foci lie in the clearance area *c*.

Additional representative reflected rays **20** and **20***a* from a front quadrant of the reflector are shown in broken lines at Fig. 2*b*. As previously stated, the front quadrants of the reflector are formed of a plurality of adjacent elliptical sections, each having their primary focus at *f* and secondary foci in the clearance area *c*. The secondary foci of the elliptical sections from which the reflected rays **20** and **20***a* are directed are shown at Fig. 2*b* at f_3 and f_4, respectively, both of which lie in the clearance area *c*.

The horizontal cross-sectional configuration of the reflector **13**, described above and illustrated in Figs. 2*a* and 2*b*, is taken in the plane of the reflector rim **13***b*. Above the plane of the reflector rim, the horizontal sections of the reflector in planes parallel to the plane of the rim, become decreasingly ovate approaching the circular opening **13***a* at the top of the reflector. The intermediate ovate sections are similar in all respects to those shown at Figs. 2*a* and 2*b*, except that the length ratio of the minor to the major axis, which is preferably at least 4/5 at the plane of the rim, increasingly approaches unity at upper reflector opening **13***a*. It will be evident that, with the major axis approaching the minor axis in length in successive horizontal planes approaching the top of the reflector from the rim, the radius of the clearance area *c* decreases as the top of the reflector is approached, until finally, at the circular section at the top, reflected rays pass through the intersection of the axes. Thus, the clearance region, in three-dimensional view, is conical in shape with its apex at the top of the reflector.

The cross section of the reflector **13** in planes normally vertical, and more particularly in all planes perpendicular to the plane of the rim of the reflector and including light rays reflected from that point of the reflector where the section is taken is a composite curve having a parabolic portion in a lower zone adjacent the reflector rim **13***b* and an elliptical portion extending from the lower zone to the upper reflector opening **13***a*. Fig. 5 shows the vertical cross-section of the reflector along the line **5—5** of Fig. 2*a*, and Fig. 4 shows the vertical cross-section of the reflector along either of the lines **4—4** of Fig. 2*a*. In general, the vertical cross-sections of the reflector in planes including light reflected from the sections are so shaped that light reflected from each section will be redirected at the highest desirable angle without impinging upon the lower edge of the reflector at the opposite side of the major axis.

The lower parabolic portion of each vertical section extends upwardly the maximum distance permitted by the reflector geometry while allowing all light reflected from the parabolic portion to pass below the reflector rim on the opposite side of the reflector. In Figs. 4 and 5, the approximate extent of the parabolic and elliptical portions in vertical cross-section are indicated by brackets adjacent the various diagrams.

The cross-section shown at Fig. 5 is taken through that portion 19 of the reflector which is parabolic in horizontal cross-section, and the parabolic lower zone 20 at this section has its focus at the effective center *s* of the light source and its axis disposed at a relatively high angle from the vertical to the nadir. By way of illustration, I have shown an angle of 74 degrees between the axis of the parabolic portion 20 of Fig. 5 and the vertical to the nadir. The upper zone 21 of the reflector in the section at Fig. 5 is elliptical in configuration and has its primary focus at f and its secondary focus at f_5, slightly below the rim of the reflector on the opposite side of the major axis. It will, of course, be understood that an intermediate portion of the other rear quadrant corresponding to the portion 19, is similar in vertical cross-section to the section at Fig. 5, the parabolic axis of the lower zone being high relative to its inclination at other points around the reflector rim.

The vertical cross-sectional view shown at Fig. 4 is taken on either side of the parabolic horizontal portion 19 of Fig. 2*b*. That is, the vertical cross-sectional view of Fig. 4 is taken at a point on the rim periphery which is of elliptical configuration in horizontal section. The sectional view shown at Fig. 4 is similar to that shown at Fig. 5, except that the lower parabolic zone 22 at Fig. 4 has its axis disposed at a slightly less angle with respect to the vertical to the nadir. By way of example, I have shown an angle of 72 degrees between the parabolic axis and the vertical, as compared with 74 degrees at Fig. 5. The upper zone of the vertical cross-sectional view of Fig. 4, indicated at 23 on the drawing, is elliptical in cross-section, having its primary focus at f and its secondary focus at f_6, slightly below the reflector rim on the opposite side of the major axis. The remaining vertical cross-sections around the reflector are similar to that of Fig. 4, except in the opposite rear quadrant portion corresponding to the portion 19.

It will now be understood that the lower zone of the reflector, which is parabolic in vertical cross-section, casts a generally conical beam of reflected light at high angles passing immediately below the reflector rim, but that those intermediate portions 19 of each rear quadrant of the reflector which are parabolic in horizontal cross-section, direct light at slightly higher angles, that is, at a lesser inclination to the plane of the rim than do any of the other vertically parabolic portions around the periphery of the reflector. This means, of course, that the parabolic portion of the main beam cast by the horizontally parabolic portion 19 of each rear quadrant, and indicated between the "60°" lines at Fig. 2*b*, is thrown out at an angle slightly higher above the vertical to the nadir than is light reflected from the lower reflector zones at any other portions around the periphery of the reflector rim.

The distribution of reflected light into two main asymmetric beams is indicated at Fig. 3, in which I have shown a plan view of a roadway including a partial light distribution diagram for one of the main reflected beams. At Fig. 3, I have shown the roadway pattern formed by the main beams of reflected light from that rear quadrant portion of the reflector shown at Fig. 2*b* as subtending 58 degrees of directly projected light. As previously pointed out, the central portion of this beam is formed of parallel rays directed at 60 degrees measured from the major axis in the plane of the rim, and is indicated by the line 24 of Fig. 3. This beam of parallel rays forms an angle of 74 degrees with the vertical to the nadir, as shown at Fig. 5. Likewise, as previously indicated, the main reflected beam is concentrated in an angle of 35 degrees measured in the plane of the rim, one of its limits being at 80 degrees with respect to the major axis and the other limit at 45 degrees with respect to the major axis measured in the plane of the rim, as indicated by the lines 25 and 26 of Fig. 3, respectively. The rays 25 and 26 are directed at vertical angles of 72 degrees with respect to the vertical of the nadir, as indicated at Fig. 4.

The foregoing description of the light distribution by a reflector embodying my invention has been based upon the assumption that the reflecting surface is specular in nature. It is possible, without disturbing greatly the general plan of light distribution, to etch the inner surface of the reflector lightly and thereby to reduce the maximum candle power and provide some additional diffused light. It will be appreciated that a certain amount of diffusely reflected light may be desirable at the outer periphery of the roadway pattern.

While I have described and illustrated a preferred embodiment of my invention in which the reflector is symmetrical on opposite sides of the major plane, I wish to have it understood that without departing from the scope of the invention, the reflector may, if desired, be so shaped that the main lateral beams directed along the roadway in opposite directions are at different angles with respect to the roadway center line.

Throughout the foregoing specification as well as in the following claims, I have referred to my reflector as an "open" reflector, and I have referred also to "vertical" and "horizontal" sections. By the use of the term "open," I do not intend to exclude from the scope of my invention reflectors of the type described when used with enclosing glassware, and indeed, I have illustrated such glassware at Fig. 1 of the drawing. By the term "open reflector" in the specification and claims, I mean merely that the reflector is shaped to function without the aid of refracting glassware, as distinguished from simple enclosing glassware. If, of course, further redistribution of light from my reflector is desired, such redistribution may be accomplished by the use of prismatic refracting glassware within the scope of my invention. Similarly, the terms "vertical" and "horizontal" have been used for simplification of description, it being assumed that the reflector is normally positioned with the plane of its rim horizontal. It will, of course, be understood that, if desired, the reflector may be mounted with the plane of the rim slightly oblique to the roadway. Thus, the words "vertical" and "horizontal" are to be understood as defining only perpendicularity and parallelism, respectively, with the plane of the reflector rim.

While I have described only a preferred embodiment of my invention by way of illustration, many modifications will occur to those skilled in the art and I, therefore, wish to have it understood that I intend in the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A roadway luminaire comprising an open ovate reflector arranged for mounting at one side of a roadway with its major plane disposed perpendicularly across said roadway, the plane of the rim of said reflector being perpendicular to said major plane and including minor and major reflector axes having a length ratio of at least 4/5, the cross-sectional configuration of said reflector in the plane of said rim being a composite curve comprising a parabolic portion in each rear quadrant and a plurality of adjacent elliptical portions having their primary foci at the point of intersection of said major and minor axes and their secondary foci lying in an annular clearance area radially spaced from said point of intersection.

2. A roadway luminaire comprising an open ovate reflector arranged for mounting at one side of a roadway with its major plane disposed perpendicularly across said roadway, the plane of the rim of said reflector being perpendicular to said major plane and including minor and major reflector axes having a length ratio of at least 4/5, the cross-sectional configuration of said reflector in the plane of said rim being a composite curve comprising a parabolic portion intermediately position in each rear quadrant and a plurality of adjacent elliptical portions having their primary foci at the point of intersection of said major and minor axes and their secondary foci lying in an annular clearance area radially spaced from said point of intersection, thereby to define a pair of discrete main beams directed asymmetrically up and down said roadway in opposite directions.

3. A roadway luminaire comprising an open ovate reflector having a plane of symmetry and arranged for mounting at one side of a roadway with said plane of symmetry disposed perpendicularly across said roadway, the plane of the rim of said reflector being perpendicular to said plane of symmetry and including minor and major reflector axes having a length ratio of at least 4/5, the cross-sectional configuration of said reflector in the plane of said rim being a composite curve comprising a parabolic portion intermediately positioned in each rear quadrant and a plurality of adjacent elliptical portions having their primary foci at the point of intersection of said major and minor axes and their secondary foci lying in an annular clearance area radially spaced from said point of intersection, and means for mounting within said reflector a light source having its effective center above the plane of said rim and lying substantially on the vertical to the nadir through the point of intersection of said minor and major axes, the cross-sectional configuration of said reflector in substantially all planes perpendicular to the plane of said rim and including light rays reflected directly from each point on the periphery of said rim being parabolic in a lower zone adjacent said rim and elliptical in an upper zone extending substantially to the top of said reflector.

4. A roadway luminaire comprising an open ovate reflector having a major plane of symmetry and arranged for mounting at one side of a roadway with said major plane disposed perpendicularly across said roadway, said reflector having a rim lying in a plane perpendicular to said major plane and having minor and major axes in planes parallel to the plane of said rim whose length ratios are at least 4/5 in the plane of said rim and increasingly approach unity at the top of said reflector, the cross-sectional configuration of said reflector in those of said parallel planes in which said axes are of unequal length being composite curves includuing a plurality of adjacent elliptical sections having their primary foci on a center line passing through the points of intersection of said major and minor axes and secondary foci lying in a conical clearance region radially spaced from said center line.

5. A roadway luminaire comprising an open ovate reflector having a plane of symmetry and arranged for mounting at one side of a roadway with said plane of symmetry disposed perpendicularly across said roadway, said reflector having a rim lying in a plane perpendicular to said plane of symmetry and having minor and major axes in planes parallel to the plane of said rim whose length ratios are at least 4/5 in the plane of said rim and increasingly approach unity at the top of said reflector, the cross-sectional configuration of said reflector in those of said parallel planes in which said axes are unequal in length being composite curves including a parabolic section intermediate the ends of each rear quadrant and a plurality of adjacent elliptical sections having their primary foci on a center line passing through the points of intersection of said major and minor axes and secondary foci lying in a conical clearance region radially spaced from said center line.

6. A roadway luminaire comprising an open ovate reflector having a major plane and a rim lying in a plane perpendicular to said major plane, said reflector being arranged for mounting with said major plane disposed perpendicularly across said roadway, the cross-section of said reflector in the plane of said rim having minor and major axes whose length ratio is at least 4/5 and comprising a parabolic portion in each rear quadrant and a plurality of elliptical portions having their primary foci at the point of intersection of said minor and major axes and their secondary foci lying in an annular clearance area radially spaced from said point of intersection, and means for mounting within said reflector a light source having an effective center lying substantially on the vertical to the nadir through said point of intersection, the cross-sectional configuration of said reflector in substantially all the planes perpendicular to the plane of said rim and including light rays reflected directly from each point on said rim being parabolic in a lower zone adjacent said rim, the axes of said parabolas being less inclined to the plane of said rim at said parabolic portions of the periphery of said rim than elsewhere on said periphery, thereby to define a pair of main asymmetric beams oppositely directed up and down said roadway.

7. A roadway luminaire comprising an open ovate reflector having a plane of symmetry and a rim lying in a plane perpendicular to said plane of symmetry, said reflector being arranged for

mounting with said plane of symmetry disposed perpendicularly across said roadway and having minor and major axes in planes parallel to the plane of said rim whose length ratios are at least 4/5 in the plane of said rim and increasingly approach unity at the top of said reflector, the cross-sectional configuration of said reflector in those of said parallel planes in which said axes are of unequal length being composite curves including a parabolic portion in each rear quadrant and a plurality of elliptical portions having their primary foci on a center line passing through the points of intersection of said minor and major axes and their secondary foci lying in a conical clearance region radially spaced from said center line, and means for mounting within said reflector a light source having an effective center lying substantially on said center line, the cross-sectional configuration of said reflector in substantially all the planes perpendicular to the plane of said rim and including light rays reflected directly from each point on said rim being parabolic in a lower zone adjacent said

rim and elliptical in an upper zone, the axes of said parabolas being less inclined to the plane of said rim at said parabolic portions of the periphery of said rim than elsewhere on said periphery, thereby to define a pair of main asymmetric beams oppositely directed up and down said roadway.

CHARLES H. REX.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,753,885	Gerhardt	Apr. 8, 1930
2,110,018	Halvorson	Mar. 1, 1938
2,140,646	Mitchell	Dec. 20, 1938

FOREIGN PATENTS

Number	Country	Date
447,864	Great Britain	May 27, 1936