June 26, 1962 M. R. ANDERSON ETAL 3,040,994

LUMINAIRE

Filed June 16, 1958 2 Sheets-Sheet 1

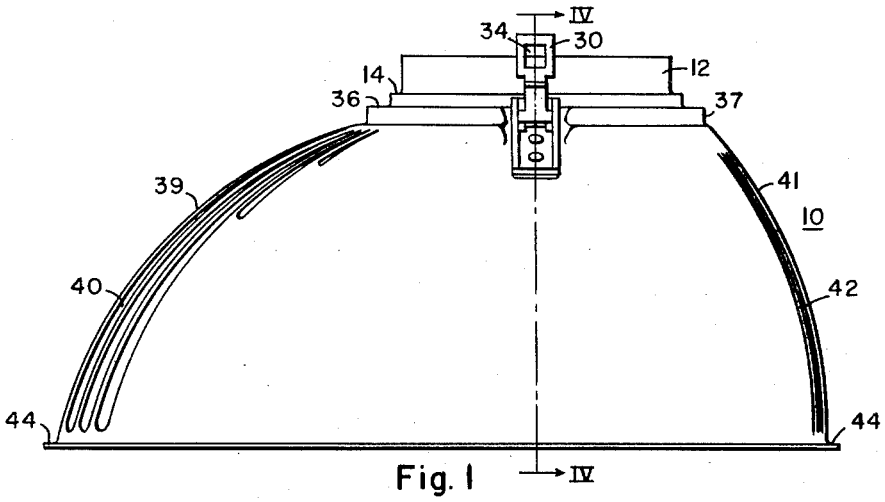

Fig. 1

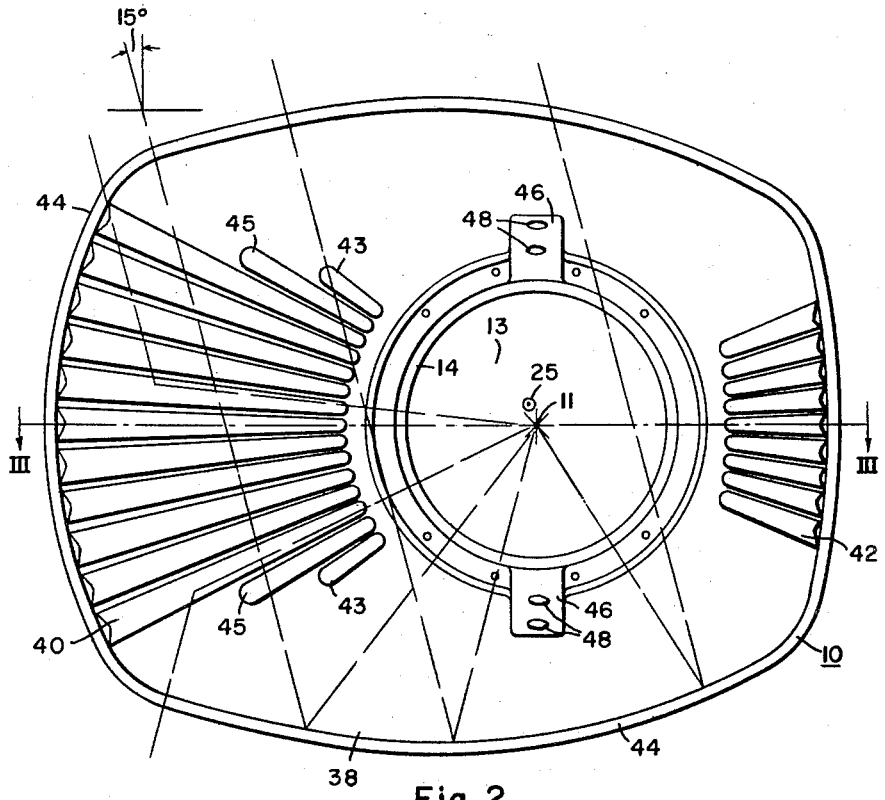

Fig. 2

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LUMINAIRE

Filed June 16, 1958 2 Sheets-Sheet 2

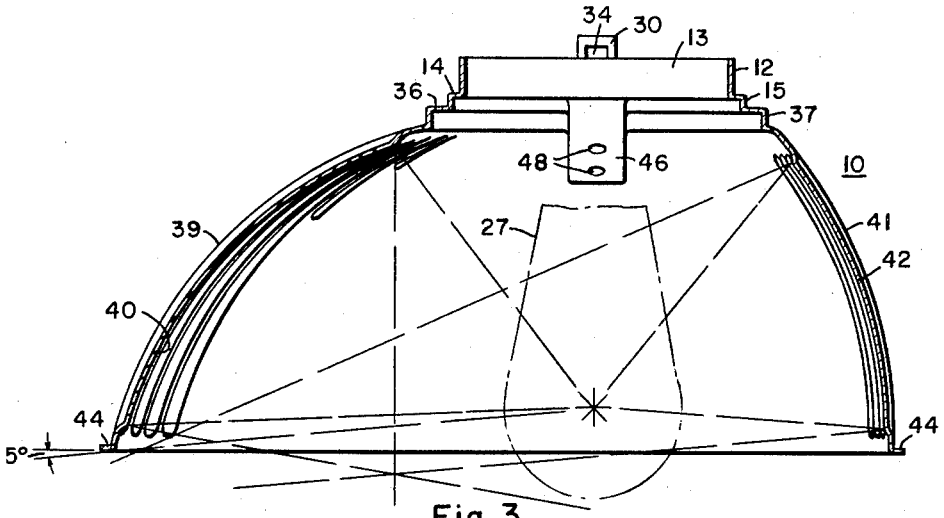

Fig. 3

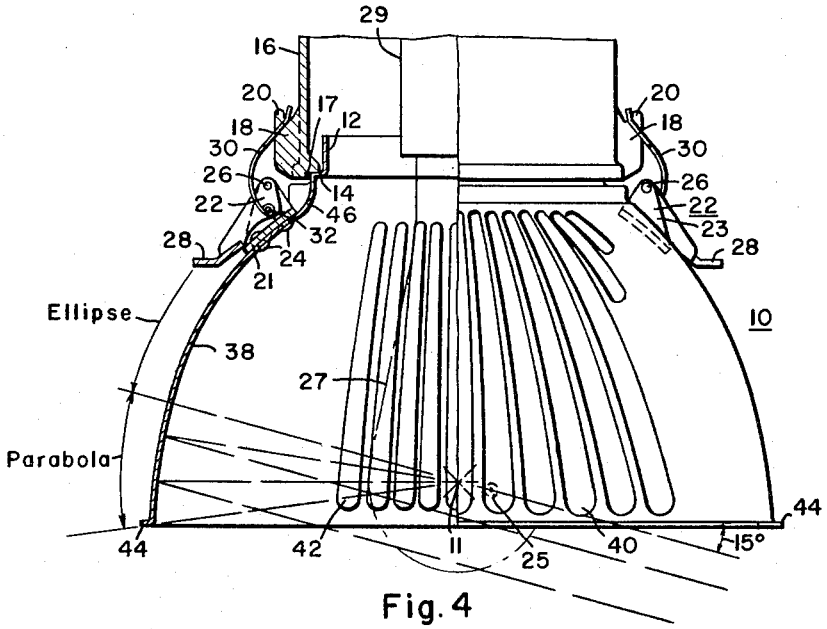

Fig. 4

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LUMINAIRE

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This invention relates to a luminaire, and more particularly to street or roadway luminaire reflectors.

In the past, it has been common to use luminaire reflectors of the open-reflector type for residential and suburban streetlighting and highway illumination. These reflectors have been objectionable because they allowed the direct light rays to be emitted from the luminaire at high angles relative to the roadway thereby dispersing the light over a large area. This light is not only lost for use on the roadway itself, but is objectionable in the homes located along the roadway.

The roadway should be illuminated to a relatively high intensity and in a substantially rectangular pattern extending outwardly from the luminaire in both directions along the roadway to obtain maximum driver visibility. The rectangular pattern should be of such a width to include the sidewalks running parallel to the roadway, but the cut-off angle should be sufficiently low so that no direct light falls upon the homes located closely adjacent to the sidewalk.

When utilizing a streetlighting luminaire having an open reflector attached to a universal head, 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. By having this arrangement, objects upon the roadway are silhouetted from a distance by the light reflected from the roadway surface. In practice, the open reflector should be designed to provide maximum light distribution over designated areas, particularly, in streetlighting wherein the streetlights are confined for the most part to one side of the roadway. To achieve a relatively uniform lighting distribution of the designated areas, it is desirable that the reflector used be designed in such a manner that all of the reflected light is emitted from the luminaire without being absorbed by or passing through the lamp or lighting source, which will also emit direct light to the designated areas.

Accordingly, the object of this invention, generally stated, is to provide a new and improved street or roadway luminaire reflector.

Another object of this invention is to provide a reflector for streetlighting luminaires shaped to distribute the light mainly in a substantially rectangular pattern along the roadway without incorporating multiple reflection of the light.

Still another object of this invention is to provide a luminaire reflector which distributes the light from the light source in a light pattern closely approximating the distribution of light from a luminaire having a refractor.

A more specific object of this invention is to provide a luminaire having elliptical, fluted ends and paraboloid sides to distribute the reflected light as effectively as possible.

Still a further object of this invention is to provide a luminaire reflector having an optical design which minimizes the absorption of light by the lighting source therefor.

Still another object of this invention is to provide a luminaire reflector which is suitable for detachable mounting to a standard universal mounting head.

A more specific object of this invention is to provide a luminaire reflector with a large neck diameter of small depth to provide easy accessibility for lamp changing apparatus when conducting relamping maintenance operations.

These and other objects, features and advantages of the invention will be made apparent during the ensuing description of exemplary forms of the invention with the description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a side elevation view of a luminaire reflector constructed in accordance with this invention;

FIG. 2 is a bottom plan view of the luminaire reflector shown in FIG. 1;

FIG. 3 is a longitudinal cross sectioned view of the luminaire reflector shown in FIG. 2, and taken substantially on the line III—III of FIG. 2; and

FIG. 4 is a front elevation view of the luminaire shown in FIG. 1, with half of the luminaire reflector being in section taken substantially on the line IV—IV of FIG. 1.

The luminaire shown on the drawings comprises a reflector **10**, which is generally ovate in form, being provided with a bottom opening so that it forms in effect one-half of an ovate spheroid. The reflector **10** is formed of one integral piece of material, preferably of a noncorrodible material such as aluminum or an aluminum alloy. Located at the upper portion of the reflector **10** is an aperture **13** having a circular mounting collar **12** formed integrally with the reflector **10**. At the base of the mounting collar **12**, there is located a flat radially extending mounting collar lip **14** which is integral with the mounting collar **12** and the reflector **10**. The mounting collar lip **14**, at its outer periphery has a cylindrical flange **15** extending downwardly for a relatively short distance. Integrally formed with the downwardly extending cylindrical flange **15** and extending radially outwardly therefrom is a mounting collar flange **36**. The mounting collar flange **36**, at its outer periphery, has a downwardly extending ring portion **37** which culminates in the main surface portions of the reflector **10**.

As shown in FIGS. 1 and 3, the ovate inverted bowl shaped reflector **10** has elliptically formed front and rear end portions which are fluted. The front wall **39** is an elongated outwardly extending wall from the ring portion **37** having an elliptical shape in both the vertical and horizontal contour which terminates in a peripheral horizontal flange **44**. The rear wall **41** has an elliptical shape in vertical contour as shown in FIG. 3, and also extends downwardly from the ring portion **37** and terminates in the peripheral horizontal flange **44**. The front wall **39** and the rear wall **41** are thus elliptical shapes and extend between horizontally located ring portion **37** and horizontally located reflector flange **44**. The front wall **39** is elongated to describe a flatter arc than the rear wall **41** relative to the horizontal reflector flange **44** of the reflector. The rear wall **41** of the reflector **10** will thereby lift and disperse reflected light flux from the light center **11** of the light source **27** (shown in dotted lines); whereas, the front wall **39** of the reflector **10** will reflect the light flux at lower angles thereby concentrating the light from these two walls in a frontal direction. The light source **27** mounted in the light socket **29** may be an incandescent or mercury vapor lamp which has a light center **11**. Ray traces as shown in FIG. 3, illustrating and describing the forward optical distribution of the light reflected from front wall **39** and rear wall **41** will be more clearly described hereinbelow.

Referring to FIG. 4, the ovate inverted bowl shaped reflector **10** has like side walls **38** symmetrically arranged opposite each other to direct reflected light emanating from the light center **11** beneath the opposite side. As shown in FIG. 4. of this specific embodiment, the lower portions of the side walls **38** have a parabolic shape extending upwardly from the reflector flange **44** for approximately a distance equal to a line drawn through

the light center **11** at an angle of 15° to the horizontal, where it intersects the side walls **38**. Above this point of intersection, the side walls **38** have an elliptical contour in the vertical plane. Referring to FIG. 2 of the drawings, the specific embodiment shown has all horizontal cross sections of the side walls **38** as having parabolic sections. Referring to FIG. 4 in conjunction with FIG. 2, it will be seen that the side walls **38** of the reflector **10** will have a parabolic contour at all horizontal sections and will have a parabolic contour in the vertical plane or sections up to the intersection of the line angled at 15° to the light center, thereby providing the lower portion of the side walls **38** of the reflector **10** with a parabolic contour. Above the 15° line referred to above, the reflector side walls **38** will have a parabolic contour in the horizontal plane with an elliptical contour in the vertical plane.

As shown in the drawings, and especially in FIGS. 2 and 4, the front wall **39** and the rear wall **41** of the reflector **10** have fluted portions **40** and **42** located thereon, respectively, which converge upwardly toward the mounting collar **12**. In the specific embodiment shown in the drawings, the longitudinal center line of each individual fluted portion is spaced approximately 5° apart with the locus of the intersection of their center lines meeting at substantially the center point of the aperture **13**. As shown in FIG. 2 of the drawings, the front flutes **40** and the rear flutes **42** are V-shaped in cross section and formed to project inwardly of the reflector **10** so that each side of each flute is formed to have inwardly facing surfaces which are at an angle of approximately 150° relative to the inner surface of the reflector **10**, whereby the sides of each V-shaped flute intersect at an angle of approximately 120°. The main flutes extend downwardly on the front and rear walls **39** and **41**, respectively, of the reflector **10**, with their upper portions substantially adjacent to the intersection of the front wall **39** with the circular ring portion **37**. Both the front flutes **40** and the rear flutes **42** extend downwardly substantially the length of the front and rear walls **39** and **41**, respectively, ending at a point closely adjacent to, but above, the reflector rim **44**. The flutes **40** and **42** are designed to reflect the light flux out of the reflector **10** and into horizontal planes consistent with the main beam angle which is herein described below. Flutes **40** and **42** are located in the front and rear walls, **39** and **41**, respectively, which have an elliptical contour in a vertical plane and a parabolic contour in a horizontal plane. Light reflected from the light center **11** by the V-shaped surfaces of the flutes **40** and **42** will be reflected outwardly of the sides of the reflector **10** as shown in FIG. 2. Light reflected from reflecting surfaces of the front and rear walls **39** and **41** other than the flutes, will not be reflected through the light center but will be reflected downward of the bottom opening of the reflector **10**. The outermost flutes **43** and **45** as shown in FIGS. 2 and 4, do not extend the entire length of the front wall **39** of the reflector **10** as it is not necessary to disperse the light in these areas as the reflector side walls **38** will adequately disperse the light without requiring fluted portions.

As shown in FIGS. 2 and 3 of the drawings, on side walls **38** there are located diametrically opposite reflector latch bases **46** having circular rivet holes **48** angularly extending downward from the mounting collar lip **14** so as to be fairing between the downwardly extending cylindrical flange **15** and the side reflector walls **38**. The width of the reflector latch base **46** is of sufficient size to accommodate the flat base portion of the latch base **22**. The latch base **22** is of a U-shape having a bight portion **21** with upwardly extending legs **23**. The bight portion **21** of the latch base **22** is secured to the reflector latch base **46** by rivets **24** passing through rivet holes **48**. Adjacent the inner end of the upwardly extending legs **23**, and extending therebetween is a latch pin **32**. A pivot pin **26**, located adjacent the outer end of legs **23** and extending therebetween, rotatably mounts a latch **28** to the latch base **22**. Latch pin **32** pivotally mounts a latch spring **30** which is of stainless steel construction having an arcuately bent shape in cross section with an aperture **34** at its remote free end. In general applications as shown in FIG. 4, the reflector **10** is mounted to a mounting hood **16** by the latch mechanism. The mounting hood **16** is generally circular in cross section having a recessed lip **17** located at its inner, lowermost periphery. Located on diametrically opposite sides of the mounting hood **16** are the mounting hood latch supports **18**. The mounting hood latch supports **18** have a hook-shaped portion **20** on their upper surfaces which are suitable for engaging the apertures **34** located in the ends of the latch springs **30**. To engage the reflector **10** to the mounting hood **16**, it is merely necessary to position the reflector **10** beneath the mounting hood **16** and then engage the apertures **34** of the latch springs **30** onto the latch hooks **20** and depress the latch handles **28**. In actuating each latch handle **28**, the latch pin **32** is rotated about the pivot pin **26** thereby putting tension on the latch spring **30** which is engaged to the latch hook **20**. By putting tension on the latch spring **30**, the reflector **10** is raised upwardly until the mounting collar lip **14** engages the recessed lip **17** of the mounting hood **16**, thereby securely locating and engaging the reflector **10** to the mounting hood **16**. The latch pin **32** is then in its overcenter position relative to the pivot pin **26** and the point of engagement of the latch spring aperture **34** of the latch spring **30** located on the latch hook **20** and the hook **20**; thereby locking the latch **28** in place until the latch **28** is raised upwardly to release the latch spring **30** from the latch hook **20**.

Referring now to FIGS. 2, 3 and 4, there is shown the light ray diagrams of the particular reflector described above. FIG. 2 shows the light rays emitted from the light center **11** as being reflected from the side wall **38** at an angle of approximately 15° relative to a perpendicular transverse line to the reference line III—III. In this example of the invention, it can be seen that the light from the side walls **38** will be directed in a forward direction after being reflected from the side walls **38** so that the reflected light will have an angular increment in the same direction as the front wall **39** relative to the light center **11**, out of the side of the reflector with a 15° toe-in. By having a 15° toe-in, the lateral distribution of the light from the side walls **38** will be directed away from the rear wall **41** and towards the front wall **39**.

In the sectional view of the reflector as shown in FIG. 3, it is seen that most of the light emanating from the light center **11** and reflected from the front wall **39** and the rear wall **41** is directed to be dispersed in a forward and downward direction. The rear wall **41** and the front wall **39** have an elliptical shape in cross section with the locus of their centers adjacent the light center **11**. Light rays emanating from the light center **11** will be reflected and dispersed by the elliptical and fluted rear wall **41** at relatively high angles; whereas, light rays emanating from the light center **11** will be reflected and dispersed by the front wall **39** at relatively low angles to illuminate areas adjacent to and generally beneath the reflector. Consequently, if reflector **10** is used as a streetlighting luminaire, for example, the reflected light will be directed generally beneath and across the street from the reflector; taking the rear wall **41** as the side of the reflector most closely adjacent to the curb.

The light rays shown in FIG. 4 show a cross-sectional view of the side wall **38** in which the bottom portion of the side wall has a parabolic contour in the vertical with an elliptical contour extending between the parabolic contour and the mounting collar **12**. The focus center **25** (FIG. 2) of the parabolic section is not the same as the light center **11** but is located closely adjacent thereto but on the opposite side of the light center **11**. By having the focus center **25** thus displaced from the light center **11**, the

light emanating from the light center **11** is reflected from the parabolic section of the side walls **38** in substantially parallel rays which do not pass through the light center **11**. The specific embodiment shown in FIG. 4 shows the main beam reflected from the parabolic section of the side walls as having an angle of substantially 75° from the vertical. By having the light rays reflected at this high angle of 75°, the light flux reflected from the parabolic section will provide a main beam area that will be reflected transverse to the longitudinal dimension of the reflector.

It is also to be noted from FIG. 3 of the drawings, that the fluted portions **40** and **42** of the front and rear walls **39** and **41**, respectively, are located at angles less than 90° to the vertical and will therefore reflect the light flux angularly away from the reflector and toward the bottom opening of the reflector. As shown in FIG. 2 of the drawings, the fluted portions **40** and **42** will disperse light rays emanating from the light center **11** in horizontal planes outwardly and angularly to the longitudinal length of the reflector **10**. The reflected light from the front wall flutes **40** and the rear wall flutes **42** will be reflected generally in the same direction as the main beams reflected from the side walls **38**; that is, the reflected beams will be dispersed outwardly of the reflector at generally low angles and substantially of the same light pattern as the main beams. By incorporating the flutes **40** and **42**, a greater distribution of reflected light will be dispersed lateral to the reflector **10**.

It will be apparent from the foregoing that a novel and efficient optical system for a luminaire has been disclosed herein. When employed in streetlighting applications, the luminaire reflector will provide lighting substantially along the length of the street with a greater area of illumination. In addition, the luminaire reflector directs a part of the light emitted from the luminaire to areas adjacent the opposite side of the street. Although this optical system has been disclosed with reference to streetlighting applications, it is not necessary that it be so limited.

Therefore, numerous modifications of the invention will occur to those skilled in the art without departing from the spirit and scope of the invention and it is to be understood that certain features of the invention can be employed without a corresponding use of other features.

We claim as our invention:

1. An optical system comprising an ovate reflector having a bottom opening, an aperture in the upper surface of said reflector, a neck extension extending upwardly about said aperture, detachable means for securing said reflector to a universal head, a light center within said reflector, opposite side walls and end walls of said reflector having a completely paraboloidal contour in the horizontal, said end walls of said reflector joining said side walls of said reflector, one of said end walls having a relatively elongated flat ellipsoidal contour in the vertical, spaced fluted sections extending the length of said end walls from the neck extension to the lowermost portion of said reflector, the central axis of each of said fluted sections converging towards the aperture of said reflector from the lower portion to the upper portion, said walls of said reflector cooperating to reflect light from said light center substantially angularly and at flat angles to said reflector.

2. An optical system comprising an ovate reflector having a plurality of reflecting surfaces comprising, a first pair of surfaces being oppositely disposed, each surface of said first pair of surfaces having a contour which is ellipsoidal in the vertical and paraboloidal in the horizontal and having formed therein a number of converging fluted sections, a second pair of surfaces being oppositely disposed, each surface of said second pair of surfaces having a contour which is paraboloidal and ellipsoidal in the vertical and which is paraboloidal in the horizontal so that substantially all light received by said surfaces will be reflected around a light source disposed substantially centrally in said reflector.

3. An optical system comprising an ovate reflector having a bottom rim defining an opening, an aperture in the upper surface of said reflector, a light source, means for mounting said light source in said reflector substantially centrally of said aperture, said light source providing a light center located above said bottom rim, opposite end walls of said reflector having a completely paraboloidal contour in the horizontal and a completely ellipsoidal contour in the vertical, spaced fluted sections extending the length of said end walls from substantiallly said bottom rim to said aperture of the reflector, the central axis of each of said fluted sections converging towards said aperture, light rays emanating from said light source being reflected by said fluted sections outwardly of the sides of the reflector and light rays emanating from said light source being reflected by the unfluted portion of said end walls downward of the bottom opening of the reflector.

4. An optical system comprising an ovate reflector having a bottom rim defining an opening, an aperture in the upper surface of said reflector, a light source, means for mounting said light source in said reflector substantially centrally of said aperture, said light source providing a light center located above said bottom rim, opposite end walls of said reflector having a completely paraboloidal contour in the horizontal and a completely ellipsoidal contour in the vertical, spaced fluted sections extending the length of said end walls from substantially said bottom rim to said aperture of the reflector, the central axis of each of said fluted sections converging towards said aperture light rays emanating from said light source being reflected by said fluted sections outwardly of the sides of the reflector and light rays emanating from said light source being reflected by the unfluted portion of said end walls downward of the bottom opening of the reflector, the foci of said opposite end walls, except for said fluted sections, being closely adjacent to but non-coincident with said light center, substantially all of the light rays received by said opposite end walls from said light source being reflected around said light source.

5. An optical system comprising an ovate reflector having a bottom rim defining an opening, an aperture in the upper surface of said reflector, a light source, means for mounting said light source in said reflector substantially centrally of said aperture, said light source providing a light center located above said bottom rim, opposite end walls of said reflector having a completely paraboloidal contour in the horizontal and a completely ellipsoidal contour in the vertical, spaced fluted sections extending the length of said end walls from substantially said bottom rim to said aperture of the reflector, the central axis of each of said fluted sections converging towards said aperture, said opposite end walls being disposed at different angles with respect to said light source and the horizontal, light rays emanating from said light source being reflected and dispersed by one of said opposite end walls at relatively high angles and light rays emanating from said light source being reflected and dispersed by the other one of said opposite end walls at relatively low angles.

6. An optical system comprising an ovate reflector having a bottom rim defining an opening, an aperture in the upper surface of said reflector, a light source, means for mounting said light source in said reflector substantially centrally of said aperture, said light source providing a light center located above said bottom rim, opposite side walls and opposite end walls of said reflector having a completely paraboloidal contour in the horizontal, said side walls having a contour in the vertical which is paraboloidal in the lower portion thereof and ellipsoidal in the upper portion thereof, said end walls having an ellipsoidal contour in the vertical, spaced fluted sections extending the length of said end walls from substantially said bottom rim to said aperture of the reflector, the central axis of each of said fluted sections converging towards said aperture, light rays emanating from said light source be-

ing reflected by said fluted sections outwardly of the sides of the reflector and light rays emanating from said light source being reflected by the unfluted portion of said end walls downward of the bottom opening of the reflector.

7. An optical system comprising an ovate reflector having a plurality of reflecting surfaces comprising, a first pair of surfaces being oppositely disposed, each surface of said first pair of surfaces having a contour which is ellipsoidal in the vertical and paraboloidal in the horizontal and having formed therein a number of converging fluted sections, a second pair of surfaces being oppositely disposed, each surface of said second pair of surfaces having a contour which is paraboloidal and ellipsoidal in the vertical and which is paraboloidal in the horizontal, a light source disposed substantially centrally in said reflector so that substantially all light received by said surfaces will be reflected therearound.

8. An optical system comprising an ovate reflector having a plurality of reflecting surfaces comprising, a first pair of surfaces being oppositely disposed, each surface of said first pair of surfaces having a contour which is ellipsoidal in the vertical and paraboloidal in the horizontal, a second pair of surfaces being oppositely disposed, each surface of said second pair of surfaces having a contour which is paraboloidal and ellipsoidal in the vertical and which is paraboloidal in the horizontal so that substantially all light received by said surfaces will be reflected around a light source disposed substantially centrally in said reflector.

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