Aug. 25, 1959 J. P. FOULDS 2,901,594

LUMINAIRE

Filed Nov. 13, 1957 2 Sheets-Sheet 1

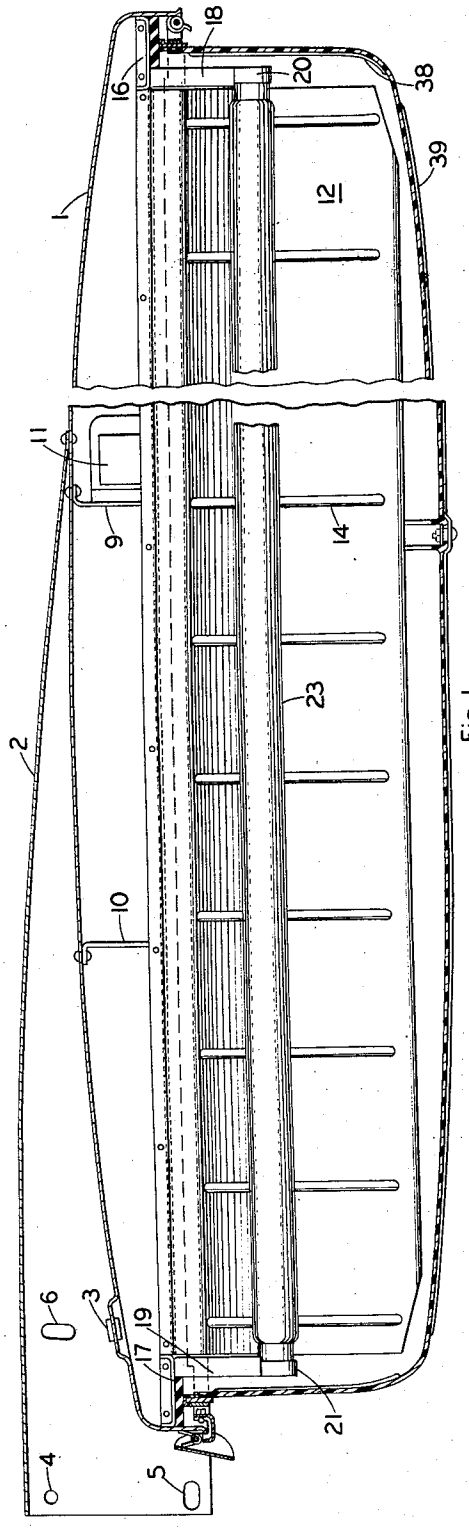


Fig. 1

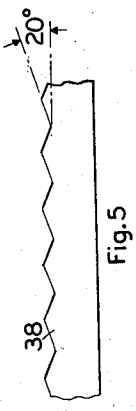


Fig. 5

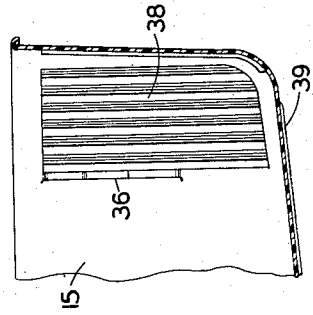


Fig. 3

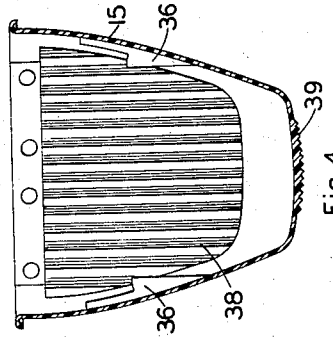


Fig. 4

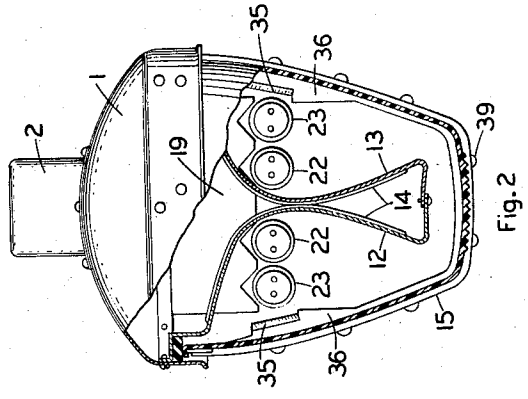


Fig. 2

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LUMINAIRE

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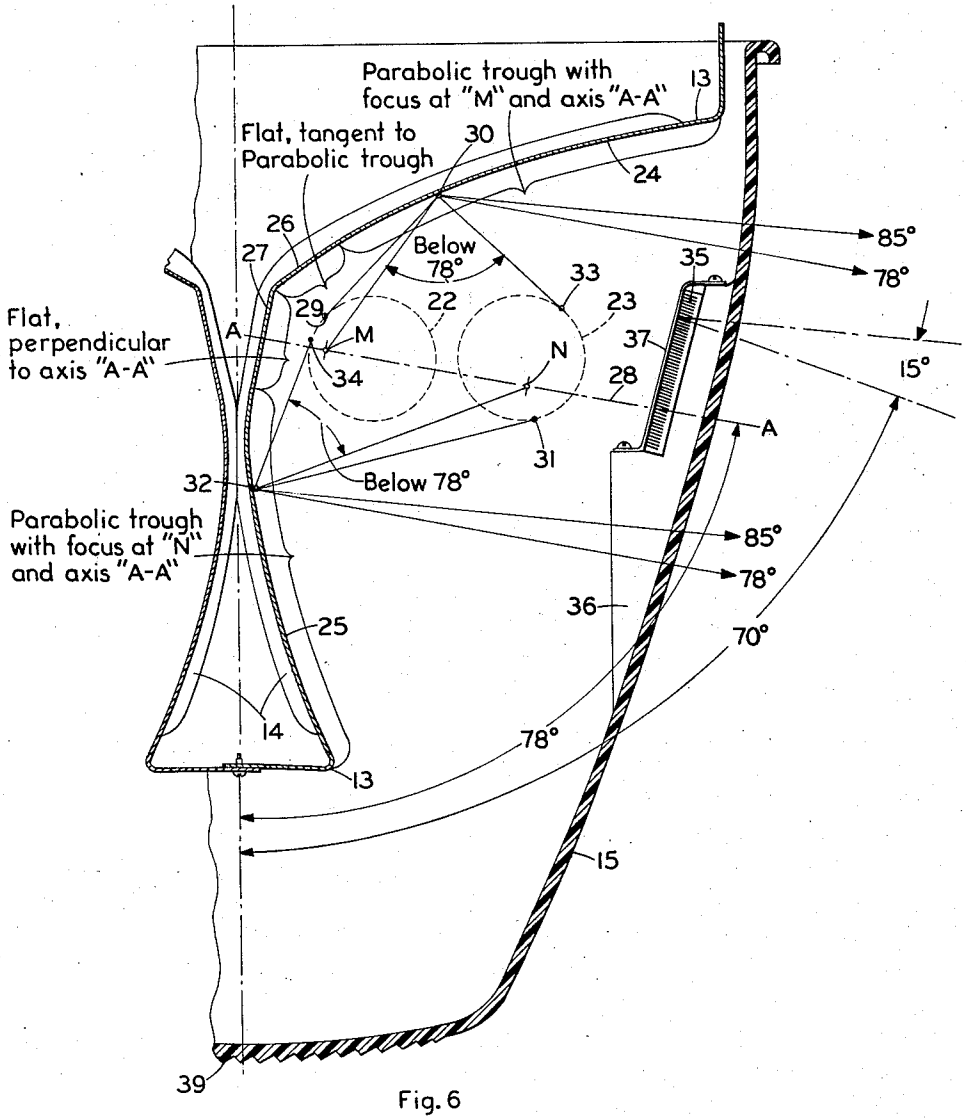


Fig. 6

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2,901,594

LUMINAIRE

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Application November 13, 1957, Serial No. 696,193

8 Claims. (Cl. 240—25)

This application is a continuation-in-part of my earlier filed application, Serial No. 357,281, filed May 25, 1953, now Patent No. 2,833,916, and assigned to the same assignee as the present invention. This invention relates to luminaires and more specifically to street or roadway lighting luminaires.

In street or roadway lighting it is desirable to have a broad pattern of pavement brightness produced by a large apparent light source mounted at a sufficient height so that the brightness of the light source at angles seen by an observer is non-productive of glare. In other words, good visibility depends not only upon adequate pavement brightness but also upon reasonable freedom from glare which may be defined as brightness in the field of vision of such character as to cause discomfort, annoyance, eye fatigue or interference with vision.

Ordinarily, luminaires or other lighting fixture equipped with plural parallel fluorescent lamps are constructed in such a way as to present a bank of lamps facing the surfaces or objects to be illuminated. A banked arrangement of fluorescent lamps prevents one lamp from obscuring another, although the plural lamps together obscure a large surface area of the reflector behind them. Consequently, the precise configuration of the reflector surface in fixtures employing banked fluorescent lamps is usually considered unimportant. Luminaires of this general type have not been particularly distinguished for their directivity, since the light emitted from them is usually scattered in all directions. The natural consequences have been inefficiency resulting from a failure to direct the light where needed and glare occasioned by emission of the light at high angles directly into the eyes of an observer. Both of these consequences, as stated, affect visibility adversely.

It is an object of this invention to provide a luminaire utilizing plural light sources in proximity to each other, which is effective in controlling the upper angular limit of specularly reflected light to reduce glare at high angles and to direct reflected light efficiently where needed for illumination purposes.

It is a further object to provide a luminaire accomplishing these objectives with a reflector structure which is of small size compared to the light sources.

It is still another object of my invention to provide a luminaire in which the direct light as well as the reflected light is carefully controlled to avoid glare at high angles.

Further objects of my invention will become apparent from a consideration of the particular embodiment thereof illustrated in the accompanying drawings.

Fig. 1 is a longitudinal sectional view of my luminaire showing certain structural features thereof.

Fig. 2 is an end view, partially in section, of my luminaire showing additional structural features thereof.

Fig. 3 is a fragmental side sectional view of an end portion of the globe showing the prism arrangement therein at its ends.

Fig. 4 is a similar end sectional view illustrating the prism arrangement in these ends.

Fig. 5 is a detail showing the natures of the prisms employed.

Fig. 6 is a partial cross sectional view of my luminaire showing the light sources and their position with respect to a reflector having longitudinal sectional portions of predetermined contour. This figure also illustrates the position of one of the louvers which is mounted on the globe in front of the light sources.

The particular embodiment of my invention illustrated in these drawings comprises an elongated hood structure supported from a cantilever-type top bracket and provided with a light transmitting globe. The globe in its closed position encloses the reflectors and the supports at the ends thereof for a plurality of elongated light sources which in the arrangement shown are tubular fluorescent lights. The surface contours of the reflectors of the luminaire are arranged relative to the light source therein to prevent reflected light from going above a desired limiting vertical angle measured from the nadir. This is accomplished in the preferred embodiment by supporting a pair of tubular fluorescent lamps in close parallelism and in a horizontal plane. The reflector structure adjacent the lamps is formed with two trough-like parabolic portions one above the other. The upper parabolic portion has a short focal length with the focal line disposed close to the inner surface of the inner lamp, while the lower parabolic portion has a somewhat longer focal length with the focal line being close to the outer surface of the outer lamp. Such an arrangement, it can be shown, directs the reflected light from the luminaire in a carefully controlled efficient fashion below an upper limiting angle, thereby also minimizing glare at high angles. A direct view of the lamps themselves is prevented at high vertical angles by means of louver strips which are mounted on and extend lengthwise of the side wall structure of the globe. Along the outside bottom portion and along its ends and sides on the inside surfaces thereof the globe is provided with prisms, one effect of which is to elongate the light source as viewed from the street and prevent a dark area along the bottom of the luminaire where the reflectors block a direct supply of light from the lamps therein. A more detailed disclosure of my invention will now be given in the following description thereof.

The mechanical design of the luminaire is such that it is supported from one cantilever-type top bracket in order to eliminate all externally positioned guides and supports therefor. The hood **1** which constitutes part of the body structure of the luminaire is hung from a channel shaped bracket **2** having a mounting portion extending beyond the inner end of the hood and a tapered portion of decreasing thickness extending along the top of the hood and having flanged edges which are attached thereto forming a hollow enclosure in the bracket. As shown in Fig. 1, the dome is provided with wiring passages **3** which extend therethrough into the enclosure of the bracket. The mounting portion of the bracket is provided with three pairs of matching bolt holes **4**, **5**, and **6**, two pairs of which, **5** and **6**, are elongated in order to provide an adjustment about a pivot point formed by the bolts extending through the bolt holes **4**. This mounting portion of the bracket may be attached to a clamp to produce a secure clamping engagement with a supporting member such as a pole. It is of course apparent that other members may be substituted for the clamp so that the luminaire may be supported on the sidewalls of buildings or on supporting means other than the pole-type support.

The hood **1** of the luminaire is reinforced by transverse braces **9** and **10** which are fastened to the down-turned

edges of the hood and also to the top of the reflectors therein in such a way that the whole structure becomes a boxed member providing the greatest rigidity possible for the weight and shapes involved. The ballast units, filament transformers, and capacitors connected in the lamp circuits are mounted within the hood on these transverse braces **9** and **10** or directly on the inside surface of the hood. The mounting of the filament transformer **11** on the brace **9** has been illustrated in the drawing, but the other parts referred to as well as the wiring has not been illustrated in order to simplify the drawing. It is of course understood that the input wires to these devices in the hood will extend through the wiring passageways **3** into the interior of bracket **2**.

Two reflectors **12** and **13**, which are mounted back-to-back and are pointed along the street in opposite directions, constitute the reflector structure of the luminaire which is mounted in the hood **1** thereof. These reflectors are provided with stiffening ribs **14** which are flattened along an area where the reflectors engage one another along their back surfaces. These reflectors extend lengthwise of the hood and each has one longitudinal edge portion attached to the hood and flanged within the hood near its point of attachment therewith to form seats for the wall structure about the opening in the elongated globe **15** of the luminaire. The other longitudinal edge portions of these reflectors **12** and **13** are bent inward toward one another and fastened to one another to provide an assembly which positions the reflectors **12** and **13** relative to one another and the hood structure **1** of the luminaire.

Two members **16** and **17**, each constituting end fillers and lamp socket supports are mounted in hood **1** at the ends of reflectors **12** and **13** so that one surface thereof forms a continuation across the ends of the reflectors of the globe seats provided by their flanged edge portions above referred to. Gasket strips of suitable material, such as neoprene sponge, are attached to these globe seats for forming a rain and dust tight connection between the globe and the body structure of the luminaire. These gasket strips may be attached to the globe seats by a suitable adhesive cement. The lamp socket supports **18** and **19** of these members **16** and **17** extend downwardly from the hood to position lamp sockets **20** and **21** at the ends of reflectors **12** and **13**. Pairs of fluorescent lights **22** and **23** are mounted in a horizontal plane between aligned sockets **20** and **21** and constitute the two light sources of the luminaire which are respectively positioned in front of each of its reflectors **12** and **13**.

As shown in Fig. 6 each reflector **12** and **13** has upper and lower trough-like portions **24** and **25** which are respectively connected along their inner edges by an intermediate trough-like portion having upper and lower parts **26** and **27**. The upper portion **24** and lower portion **25** of each reflector each have reflecting surfaces of parabolic cross section. The upper portion **24** has a short focal length with the focus at M close to the innermost edge of the inner lamp **22**, while the lower portion **25** of the reflector has a longer focal length with the focus at N close to the outermost edge of the opposite side of the outer lamp **23**. In the preferred embodiment illustrated the focal lines M and N of these two parabolic trough-like sections lie in an axial plane **28** which is common to both of them. The axial planes of the two parabolic portions need not be exactly coincident but can also be spaced apart somewhat provided they are parallel. For equivalent performance, however, a reflector combination in which the two parabolic portions have common axial planes can be made smaller than one in which the axial planes are spaced apart. It will be noted that the major portions of each of the light sources **22** and **23** is located between planes extending through the focal lines M and N at right angles to the common axial plane **28**. The arrangement of parts thus provided controls the upper limit of specularly reflected light from the reflector. With this arrangement of lamps positioned relative to the upper and lower parabolic portions of the reflector all the light from the lamps which reaches the upper portion **24** of the reflector falls below a limiting vertical angle and all the light from the lamps intercepted by the lower portion **25** of the reflector is likewise reflected below this same limiting vertical angle. As will be pointed out below this limiting vertical angle is only a few degrees above the angle of the axial plane which in the arrangement illustrated is at 78° to the vertical.

In order to keep the size of reflectors **12** and **13** within practical, economical limits, it is desirable to introduce a flat portion of the reflector at the lower edge of the upper parabolic portion **24** in order to prevent the light from the lower portion of the inner lamp from going above the upper limit of specularly reflected light which has been previously established. Thus, the part **26** of the intermediate portion of the reflector is flat and tangential to the parabolic portion **24** at its lower edge. The other part **27** of the intermediate portion of the reflector may also be made flat and in the arrangement illustrated presents a surface perpendicular to the axial plane **28**. This part **27** of the intermediate portion of the reflector is just a convenient means of connecting the part **26** thereof with the inner edge part of the lower parabolic portion **24**. The cross-sectional curve shape of part **27** is not important since the light reflected therefrom is blocked entirely by lights **22** and **23**.

The configurations of the parts **24**, **26**, **27** and **25** of the reflector have been identified by legends applied to the drawing. The arrangement is such that a light source, having appreciable size relative to the reflector, is placed in relation to the foci of the upper and lower parabolic troughs so that the angle between the focus of the upper parabolic trough and the innermost edge of the light source and the angle between the focus of the lower parabolic trough and the outermost edge of the light source are not greater than the angle between the axes of these parabolas and the desired limiting vertical angle. In the arrangement illustrated the light reflected from these surfaces is confined below a limiting vertical angle of 85°. It will be noted that a ray of light emanating from the innermost edge **29** of light source **22** and striking the reflecting surface of the parabolic portion **24** of the reflector at **30** does not extend upwardly beyond the 85° angle as illustrated in the drawing. The same is true of light emanating from the outermost edge of lamp **23** at point **31** which strikes the lower parabolic portion of the reflector at point **32**. Light rays reflected from the flat part **26** of the intermediate portion of the reflector, which is tangential to the inner edge of the upper parabolic portion **24** thereof, are also limited in their vertical spread to no greater than 85° above the vertical. Of course, those light rays that come from the focal lines M and N and impinge upon the parabolic portions **24** and **25** at points such as **30** and **32** above selected for purpose of illustration, will be reflected parallel to the axial plane **28** which is at 78° to the vertical. Furthermore all light between focal line M and outermost edge portions **33** of lamp **23** which impinge at point **30** on upper portion **24** of the reflector will be directed below the angle of the axial plane **28** which is at 78° to the vertical. In like manner light from the lamps **22** and **23** between focal line N and innermost edge portion **34** of lamp **22** will fall below this angle of 78°.

This arrangement of plural light sources and reflecting surfaces is such that one source, the outer one, appears to obscure the inner one. Actually, placing the two sources alongside each other instead of one above the other permits a greater use to be made of the adjacent reflecting surfaces, giving a greater directional control to the beam pattern produced by the luminaire. As is generally appreciated in the lighting arts, the placing of two or more tubular fluorescent lamps in close parallelism naturally results in raising the intensity of light emitted from the surfaces of the lamps facing each other, since

much of the light impinging on these surfaces is absorbed and reradiated. With the arrangement of light sources and reflecting surfaces shown, the reflectors are in a position to utilize the increased brightness of the intermediate lamp surfaces by directing the light therefrom into the beam at an angle below the limiting vertical angle. By contrast, where the lamps are arranged in a vertical or nearly vertical bank, no such fine control over beam directivity is possible.

In order to reduce at high angles the brightness of the luminaire caused by direct light from the lamps **22** and **23**, it may be desirable to provide the luminaire with louver strips **35** which may be mounted on the inside side surfaces of the globe in front of the lamps therein. In the arrangement illustrated these louver strips have been mounted on brackets **36** which are attached along one edge to the inside side surfaces of the globe. The louver strips in turn are held in place on shouldered portions of these brackets by clamping bands **37**.

The particular louver strip employed is made of a plastic material having parallel cuts extending about three quarters of the way therethrough. In accordance with its mounting, these parallel cuts in the louver strips are inclined at a predetermined angle to the vertical and the irruglarities of their cut surfaces produce a translucence which reduces the brilliance of the light source when viewed therethrough. The parallel louver slits in the arrangement illustrated are so arranged that there will be no light directly from the lamps at angles from 85° to 90° up from the vertical. Therefore, the light which would normally shine from the lamps in that direction is diffused by the nature of the cut slits in the plastic in order to reduce their brightness as viewed from those angles. In the arrangement illustrated it will be noted that the angle between the outside edge of an upper cut and the inside edge of a lower cut is at 15° to the plane of a cut. The translucence of the cuts reduce the intrinsic brightness of the source as viewed by an observer to approximately 10 percent of what it would be if the lamps were viewed directly. It will be noted that when the louver is mounted on the globe of the luminaire, the transparent material between the cuts or slots is at 70° to the vertical, and consequently, the full light intensity is transmitted from the lamps at this angle to the vertical.

The good directional control in the beam direction and diffuse light in other directions which the above described plastic louver strip provides distinguishes it over louvers made of opaque materials which either cast dark shadows or reflect light right through the louver in undesired directions. A luminaire such as the one described including the unique reflector configuration and the plastic louver strip set forth herein is remarkably glare-free at high angles. Furthermore, when the lamps are lit, not only is the lastic louver itself indiscernible, but the entire area from top to bottom of the reflector surface is so evenly illuminated that it is difficult to see the location of the light sources. Both of these factors contribute beneficially to the appearance and efficiency of the luminaire in operation.

Globe **15** of the luminaire is preferably transparent and made of a clear molded plastic material. For convenience in manufacture it may be made in two pieces which when joined along their inner open ends form the completed globe. The two parts may be made of equal size and in the same mold thereby reducing the cost of manufacture. As best shown in Figs. 2, 3 and 4, prisms **38** are provided on the inside end surfaces of the globe and prisms **39** are provided on the outside bottom portion thereof. As shown in Fig. 5 these prisms are symmetrical and have facing surfaces with an angularity of 20°. These prisms are provided for their obscuring effect at the ends and bottom of the globe, but may be faced to secure a desired distribution of light. They also serve to effect an elongation of the light source as viewed from the street and to prevent a dark area along the bottom of the luminaire where the reflector thereof blocks a direct supply of light from the lamps therein.

It is quite obvious that the particular embodiment of my invention above described may be variously modified without departing from the spirit and scope of my invention. Thus, instead of the particular fluorescent lights shown and described above, other rectilinear light sources may be substituted therefor. These rectilinear light sources, for example, may comprise a plurality of units arranged lengthwise of one another in order to obtain a light source of the desired length. It is also apparent that the reflectors of my luminaire need not be of the continuous contour illustrated and described above since they may be made of a plurality of elements which in combination have the effect of such continuous contour. Thus, for example, the completed reflectors in each case may be made up of a plurality of longitudinal extending flat surfaces which are arranged relative to one another to secure an equivalent of the contour and trough-like arrangement above described. It is also apparent that instead of using two lamps in front of each reflector, more than two lamps may be employed without departing from my invention. As previously suggested the globe prisms may be faced so that light at the ends of the globe is directed towards the street. Various other details of construction may likewise be modified by employing different physical arrangements having the same functional utility. Thus, while I have described only one preferred embodiment of my invention, the above modifications and others will doubtless occur to those skilled in the art and I, therefore, intend to cover in the appended claims 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 luminaire comprising: a reflector mounted to face away from a fixed vertical plane and having upper and lower trough-like portions, each of which has a concave reflecting surface of parabolic cross-section, said upper and lower portions of said reflector having a common axial plane and said upper portion having a shorter focal length than that of said lower portion, the focal lines of said parabolic portions being parallel with the focal line of said upper portion located closer to said vertical plane than the focal line of said lower portion; and means for supporting a pair of laterally spaced rectilinear light sources with each of said sources lengthwise of one of said focal lines of said upper and lower reflector portions and with the major portions of said light sources located between planes including said focal lines and extending at right angles to said common axial plane.

2. A luminaire comprising: a reflector mounted to face away from a fixed vertical plane and having upper and lower trough-like portions each having a reflecting surface of parabolic cross-section, said upper and lower portions of said reflector having a common axial plane with the focal line of said upper portion located closer to said vertical plane than the focal line of said lower portion, both said focal lines being parallel to one another; and means for supporting a pair of tubular rectilinear light sources one along each of said focal lines with the innermost surface of the inner light source close to the focal line of said upper portion of said reflector and with the outermost surface of the outer light source close to the focal line of said lower portion of said reflector.

3. A luminaire comprising: a reflector mounted to face away from a fixed vertical plane and having upper and lower trough-like portions with reflecting surfaces of parabolic cross-sections, said reflector portions having a

common axial plane with said upper portion having a shorter focal length than said lower portion and with the focal lengths of each of said portions being parallel to one another, the focal line of said upper portion being located closer to said vertical plane than the focal line of said lower portion; and means for supporting a tubular rectilinear light source along each of said focal lines with the innermost surface of the inner light source close to the focal line of said upper portion of said reflector and with the outermost surface of the outer light source close to the focal line of said lower portion of said reflector.

4. A luminaire having a body structure; inner and outer supporting means mounted on said body structure for positioning inner and outer rectilinear light sources parallel to one another and spaced laterally of said body structure; and a trough-like reflector mounted on said body structure to face away from a fixed vertical plane and having an upper reflector surface of parabolic cross-section extending lengthwise of said body structure with its focal line within the cross-sectional boundary of the light source mounted in said inner supporting means therefor, and a lower reflector surface of parabolic cross-section extending lengthwise of said body structure with its focal line within the cross-sectional boundary of the light source mounted in said outer supporting means therefor, each of said reflecting surfaces having a common axial plane directed at a predetermined vertical angle measured from the nadir.

5. A luminaire having a body structure; inner and outer supporting means mounted on said body structure for positioning inner and outer rectilinear light sources parallel to one another and spaced laterally of said body structure; and a trough-like reflector mounted on said body structure to face away from a fixed vertical plane and having an upper reflector surface of parabolic cross-section extending lengthwise of said body structure with its focal line within the cross-sectional boundary of the light source mounted in said inner supporting means therefor, and a lower reflector surface of parabolic cross-section extending lengthwise of said body structure with its focal line within the cross-sectional boundary of the light source mounted in said outer supporting means therefor, each of said reflecting surfaces having a common axial plane directed at a predetermined vertical angle measured from the nadir, said supporting means positioning the light sources relative to said reflecting surfaces in order to confine the light beam reflected from said surfaces below a limiting vertical angle with the angle between light rays from the focal line of said upper reflector and from the innermost edge of the inner light source to any point on said upper reflector surface being no greater than the angle between said limiting vertical angle and said predetermined vertical angle, and with the angle between light rays from the focal line of said lower reflector and from the outermost edge of the outer light source to any point on said lower reflector surface being no greater than the angle between said limiting vertical angle and said predetermined vertical angle.

6. A luminaire having a body structure; inner and outer supporting means mounted on said body structure for positioning inner and outer rectilinear light sources parallel to one another and spaced laterally of said body structure; a trough-like reflector mounted on said body structure to face away from a fixed vertical plane and having an upper surface of parabolic cross-section extending lengthwise of said body structure with its focal line within the cross-sectional boundary of the light source mounted in said inner supporting means therefor, and a lower reflector surface of parabolic cross-section extending lengthwise of said body structure with its focal line

within the cross-sectional boundary of the light source mounted in said outer supporting means therefor, each of said reflecting surfaces having a common axial plane directed at a predetermined vertical angle measured from the nadir, said supporting means positioning the light sources relative to said reflecting surfaces in order to confine the light beam reflected from said surfaces below a limiting vertical angle with the angle between light rays from the focal line of said upper reflector and from the innermost edge of the inner light source to any point on said upper reflector surface being no greater than the angle between said limiting vertical angle and said predetermined vertical angle and with the angle between light rays from the focal line of said lower reflector and from the outermost edge of the outer light source to any point on said lower reflector surface being no greater than the angle between said limiting vertical angle and said predetermined vertical angle; and a louver strip mounted opposite the outermost edge of said outer light source to shield said light sources from direct view at angles above said limiting vertical angle, said louver strip being formed of a transparent material having spaced louvers of translucent material arranged parallel to one another and directed at a downward angle, said translucent louvers being dimensioned to prevent direct transmittal of light from said light sources at angles greater than said limiting vertical angle.

7. A luminaire for directing light below a limiting vertical angle to prevent glare at angles greater than said limiting vertical angle comprising: an elongated trough-like reflector combination mounted in said luminaire facing away from a given vertical plane and having upper and lower reflecting portions parabolic in cross-section, the parabolas of said upper and lower portions having their axial planes directed downwardly at a common angle to said vertical plane, the focal line of said upper reflector portion being located closer to said vertical plane than the focal line of said lower reflector portion; and means for supporting a pair of rectilinear light sources in said luminaire lengthwise of said trough-like reflector combination with each of said light sources located along one of said focal lines, the major portions of both said light sources being located between planes including said focal lines and extending at right angles to said axial planes.

8. A luminaire for directing light below a limiting vertical angle to prevent glare at angles greater than said limiting vertical angle comprising: an elongated trough-like reflector combination mounted in said luminaire facing away from a given vertical plane and having upper and lower reflecting portions parabolic in cross-section, the parabolas of said upper and lower portions having their axial planes directed downwardly at a common angle to said vertical plane, the focal line of said upper reflector portion being located closer to said vertical plane than the focal line of said lower reflector portion; and means for supporting a pair of tubular fluorescent light sources in said luminaire lengthwise of said trough-like reflector combination with each of said light sources located to include one of said focal lines within its cross-sectional boundary and with the inner edge of the inner light source close to the focal line of said upper portion of said reflector and with the outer edge of the outer light source close to the focal line of said lower portion of said reflector.

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