May 12, 1959 W. H. DORMAN 2,886,698

STREET LIGHTING LUMINAIRE

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Fig. 1

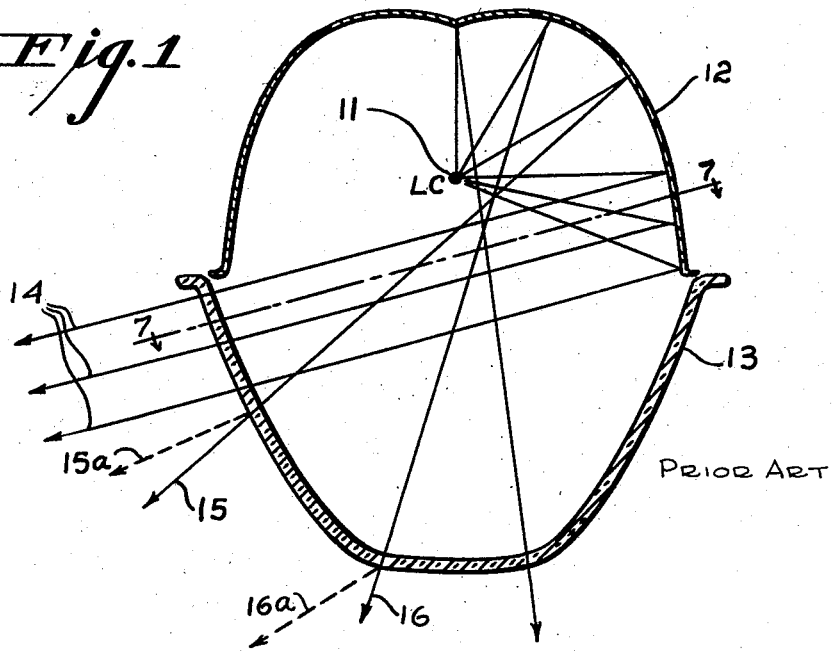

Fig. 2

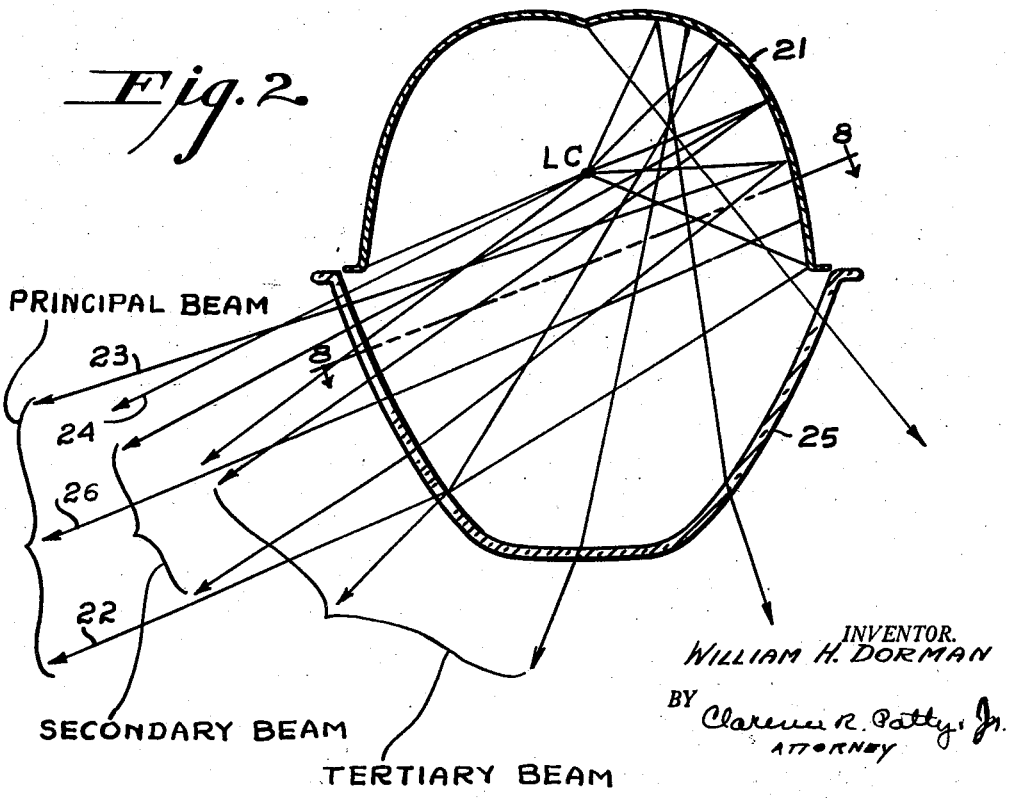

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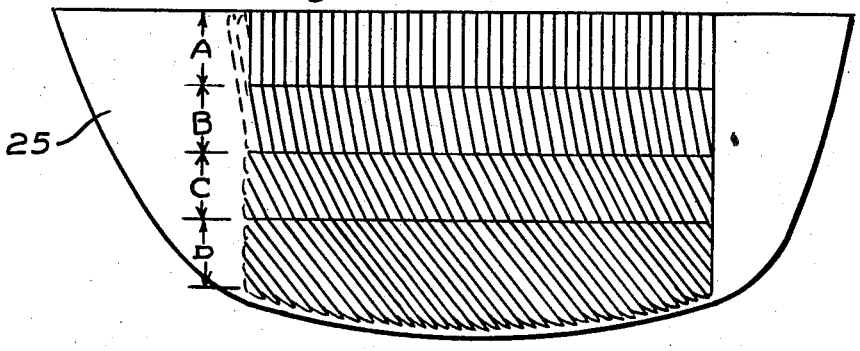
Fig. 3



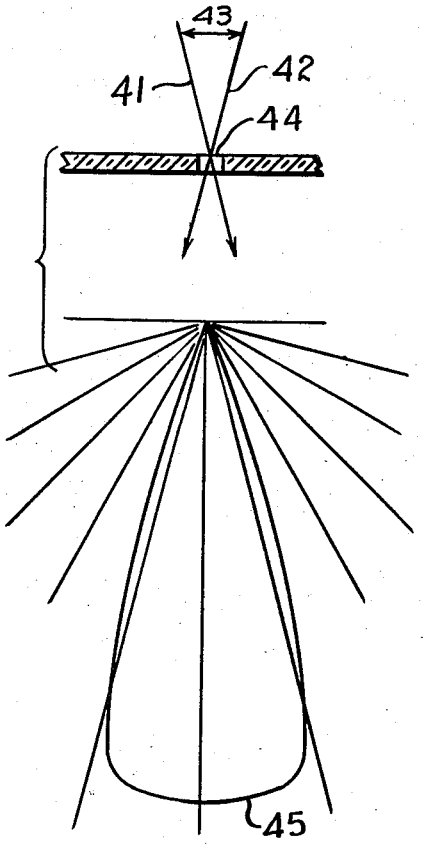


Fig. 4

Prior Art

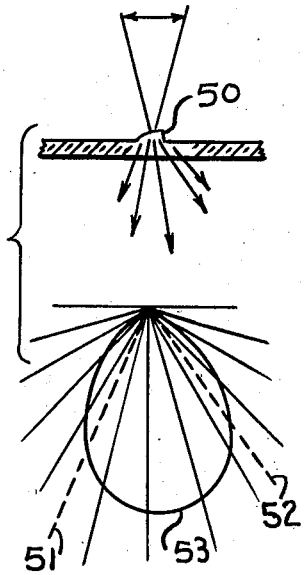


Fig. 5

Prior Art

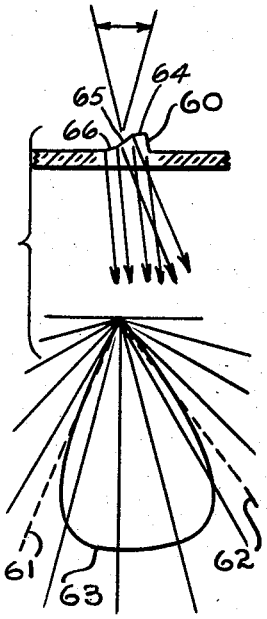


Fig. 6

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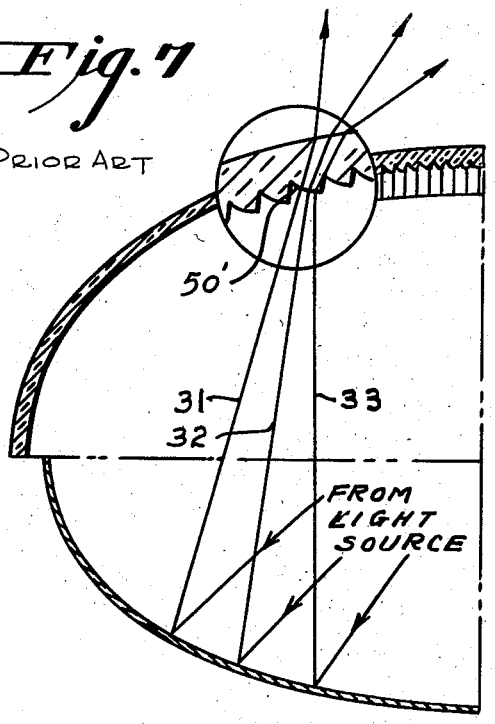
Fig. 7

PRIOR ART



PRIOR ART

Fig. 7a

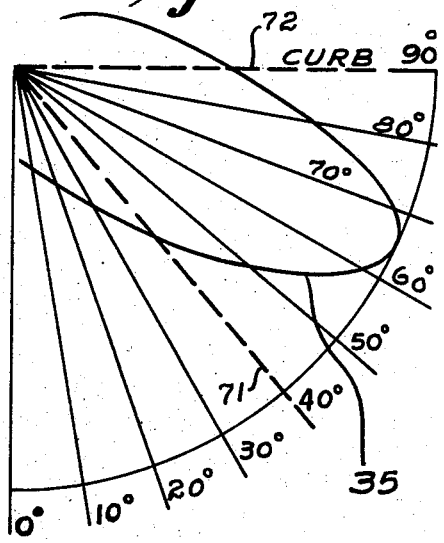


Fig. 8

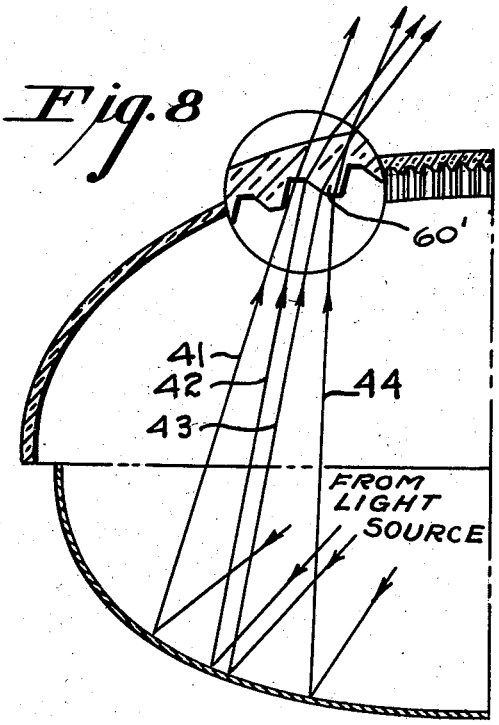
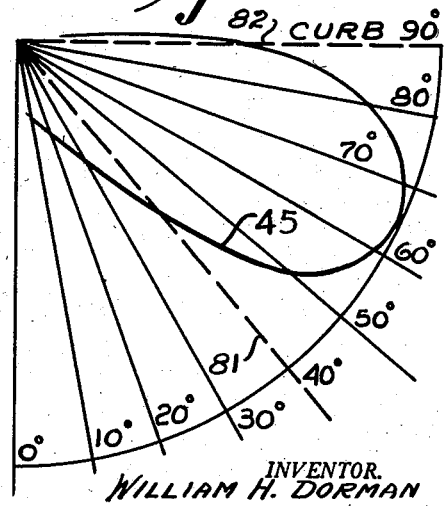


Fig. 8a



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STREET LIGHTING LUMINAIRE

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Application April 26, 1955, Serial No. 503,880

2 Claims. (Cl. 240—25)

The present invention relates to street lighting luminaires and is more particularly directed toward such luminaires with light refracting globes underneath the light source and reflector.

A known form of street lighting luminaire employs a downwardly acting reflector with a cut-off angle approximately horizontal and having a contour to reflect most of the light out below the mouth of the reflector at angles high enough above the nadir to fall on remote areas of the street. Such reflectors are customarily closed by globes provided with prisms on their inner surfaces to give various asymmetric light distribution patterns for employment at overhead street locations which may vary from the center to the side of the street.

The type of luminaire just referred to is characterized by a very high brightness appearance of the globe in its principal region just below the top of the refractor where the dominant light rays are reflected out at high angles for lighting remote street areas and, below this region of high brightness, the globe, when viewed from remote points of observation, has lower regions of very low brightness, the reason being that the lower part of the globe transmits most of the light at angles substantially below the dominant beam.

The faults of such luminaires have long been recognized and attempts made to overcome them. In one example the globes have been provided with light refracting surfaces adapted to elevate some of the light which normally falls on the nearer areas of the street, so that more light will be emitted into the same general direction above the nadir as the dominant beam. A globe of such design, although an improvement on that first discussed, in common therewith has the fault that it still materially lacks uniformity in brightness appearance.

A common method of obtaining increased divergence or spread of direct and reflected light is by means of flutes. Practice has shown that when light is incident on a flute from an extended source, that the radius of curvature of the flute must cause divergence of the light greater than the included angle of incident light from the extended source before any useful increase in spread or divergence can be obtained. This, however, requires a flute which has a radius of curvature that is often too sharp to be in conformance with good glass molding practices. Moreover, in a glass refractor when direct or reflected light rays from an extended light source converge on a single flute, designed to give the light additional divergence or spread, the refracted light loses its sharp cut-off characteristics and a portion thereof is dispersed at wide angles into non-useful areas outside the roadway pattern. This effect is a distinct disadvantage, resulting in a lower percentage of light falling on the street or roadway area. As is known, in all luminaire structures in which steep prisms and deflecting flutes are employed, a certain amount of usable light is lost because of the shadowing effect of the prism or deflecting flute riser. In the case of a steep riser, whose face is parallel with the incident light rays, a certain portion of usable light is lost.

According to the present invention a downwardly acting quasi-elliptical reflector is provided with its mouth substantially below the level of the light source it surrounds. Such a reflector, oriented with its long axis transverse to the street or roadway, is generally parabolic in longitudinal planes parallel with an angle of approximately 75° to nadir the axis of the parabola generally making an angle of ten or fifteen degrees to the curb line. The reflector is asymmetrical in vertical planes parallel to the axis of the parabola, thus causing the reflected light to be emitted in vertically diverging rays across the mouth of the reflector at high angles above nadir.

The globe or refractor fitted across the reflector mouth has an upper region provided with prisms adapted for transmitting the intercepted reflected rays and the high angled direct rays to supply the principal beam toward remote street areas without vertical deviation, and in progressively lower regions is adapted for refracting rays intercepted from the other regions of the reflector at angles parallel to the higher angled rays transmitted from the upper regions thereof to supply secondary and tertiary beams. Moreover, the refractor in the lower regions is provided with zones or bands of variant refracting power prisms which range in direction from vertical to substantially horizontal through intermediate angles and function to elevate and laterally deflect the light transmitted by them into substantial parallelism with the direct and reflected rays emitted from the upper regions of the refractor so that the entire refractor, when viewed from regions into which the dominant direct and reflected light is directed, is substantially uniformly luminous.

Moreover, in lieu of the use of steep riser prisms or deflecting flutes there are provided compound prisms each having a number of flat faces of different refractive power, hereinafter for convenience referred to as "duplex" prisms, to give the necessary divergence to incident light from an extended source and which are of a practical contour for good glass molding practices.

The effect of these prisms is to split and offset end to end the image of an extended source such as would normally be projected through a slit of the width of one prism. In this way the sharp cut-off characteristic found at the edge of the source image is preserved and the transmitted light more nearly contained within the bounds of the projected light beam itself. The risers of such duplex prisms are more nearly parallel to the incident rays and are substantially remote from the highly refractive portions thereof so as not to block off the high angled internally refracted rays, thereby making use of a substantial amount of usable light which is ordinarily lost at the risers.

For a better understanding of the invention reference is had to the accompanying drawings which show, for the purpose of illustrating the present invention, one of the many embodiments in which the invention may take form, it being understood that the drawings are illustrative of the invention rather than limiting the same.

In the drawing:

Fig. 1 is a diagrammatic sectional view through a prior art type of luminaire and the light ray distribution thereby.

Fig. 2 is a view, similar to Fig. 1, of a luminaire embodying the invention.

Fig. 3 is a diagrammatic side elevation of the principal beam forming prism arrangement of Fig. 2.

Fig. 4 is a schematic diagram showing candle power distribution of light from an extended source passing through a narrow slit.

Fig. 5 is a schematic diagram showing a modified candle power distribution of light passing through a single light diverging prism or flute designed to give increased spread to incident light.

Fig. 6 is a schematic diagram showing candle power

distribution of light passing through the novel form of duplex prism embodying the invention.

Fig. 7 is a diagrammatic cross section of the luminaire shown in Fig. 1 taken on line 7—7 thereof.

Fig. 7*a* illustrates the candle power distribution over a highway resulting from a deflecting flute arrangement such as shown in Fig. 7.

Fig. 8 is a diagrammatic cross section of the luminaire of Fig. 2 taken on line 8—8 thereof.

Fig. 8*a* illustrates the candle power distribution over a highway resulting from a deflecting flute arrangement such as shown in Fig. 8.

In Fig. 1 the prior art type of luminaire is illustrated as employing a light source **11** about which is arranged a downwardly acting ovate reflector **12** and an enclosing globe or refractor **13**. The lower part of reflector **12** is ordinarily parabolic and designed to send out parallel main beam reflected light rays illustrated at **14** at the desired angle, typically 75° above nadir. Most of the light emitted, however, is confined to the top portion of the refractor. Some of the light, however, such as represented by rays **15** and **16**, passes out at such low angles as to fall on nearby street areas. When such a globe is viewed from a remote street area it has a very bright zone at the top and a relatively dark zone in the lower regions thereof. The globe **13** is sometimes provided with light diverging prisms, hereinafter referred to as deflecting flutes, adapted to elevate some of the light rays such as **15***a* and **16***a* to improve the luminous appearance of the globe.

The new luminaire of Fig. 2 employs an ovate reflector **21** that is generally parabolic in longitudinal planes parallel with an angle approximately 75° from nadir, in the region below and slightly above the light source, the axis of said parabola making an angle of ten to fifteen degrees with a line parallel to the curb of the street, and in vertical planes parallel to the axis of the parabola the reflector has a continuously changing radius of curvature so that light rays such as **22** reflected from the lower region of the reflector diverge from those rays such as **23** reflected from a higher region thereof.

The globe **25**, in the upper region A (Fig. 3), is provided with prisms adapted for transmitting reflected high angle rays such as **23** and the high angle direct rays such as **24** toward remote street areas without vertical deviation and in progressively lower regions B, C and D with prisms adapted for refracting rays such as **26** and **22** at angles substantially parallel to the higher angled rays **23** and **24**. Also the refractor in its regions B, C and D is provided with zones of variant refracting power prisms which deflect the light rays such as **26** and **22** transmitted by them into substantial parallelism with rays **23** and **24** so that the globe is made to appear substantially uniformly luminous. As will be understood, the prisms in zone A being vertical have only the lateral refracting component necessary to give the beam its proper lateral aim or toe-in.

In zone B since the light striking the refractor is slightly divergent in a vertical plane from the light that strikes zone A, some vertical lift is required to bring it into proper parallelism with the light in zone A. By tilting the prisms from the vertical, as in zone B, a vertical refracting component is obtained sufficient to accomplish this purpose in addition to providing the necessary lateral deflection. Since light striking zones C and D is progressively more divergent, progressively more tilt is required to the prisms to obtain the necessary parallelism with the rays transmitted from zone A.

In many cases the lateral beam width, provided by the light source, and its reflector, is not sufficient to meet modern street lighting practices. It has, accordingly, been common practice to add deflecting flutes which will give some divergence to the light to obtain such necessary beam width.

As is known, light rays **41** and **42** (Fig. 4) from an extended source **43** in passing through a narrow slit **44** of a single prism width will have a light distribution such as shown by the candle power distribution represented by the envelope **45**.

When a deflecting-flute **50** is used, as in Fig. 5, to both deflect the light pattern and give increased spread to it, much of the light is refracted into zones outside the desired beam area, as illustrated by the bulge in the candle power distribution curve outside the interrupted lines **51** and **52** defining the lateral boundaries of such area.

According to the present invention a duplex prism **60**, having flat faces such as **64**, **65**, and **66** in which the refracting power of face **65** differs from that of faces **64** and **66** as shown in Fig. 6, provides for splitting and displacing the source image normally transmitted through a slit, into two portions arranged end to end, thereby maintaining the sharp cut-off characteristics found at the edge of the source image, as illustrated in Fig. 4. These combine into a candle power distribution pattern represented by the envelope **63** wherein the bulk of the light is confined within the region between the interrupted dotted lines **61** and **62** indicating the lateral limits of the desired spread.

Referring now to Figs. 7 and 7*a* the light rays **31**, **32**, **33** converge upon a single light deflecting flute **50'**, such as the flute **50** described in Fig. 5. The resultant collective light distribution of groups of such flutes in a refractor such as **13** (Fig. 1) produces a candle power distribution pattern such as shown by the envelope designated **35**, wherein it will be observed that considerable of the light falls outside the useful area defined by interrupted line **71** and line **72** defining a street curb.

In street lighting design a beam width is specified as the candle power points which are one half the maximum candle power value indicated in Fig. 7*a* by the interrupted lines. In this particular case it will be noted that a very considerable amount of light falls outside these limiting lines into non-useful areas.

In Fig. 8 the light rays **41**, **42**, **43** and **44** are converging upon a single duplex prism **60'** embodying the invention, such as the prism **60** disclosed in Fig. 6. The resultant collective light distribution of groups of such prims in a refractor such as **25** (Fig. 2) produces a candle power pattern such as shown by the envelope **45** of Fig. 8*a*.

In the case of the showing in Figs. 8 and 8*a*, employing duplex prisms, a comparatively small portion of the light pattern falls outside the interrupted lines **81** and **82** because of the sharp cut-off characteristics of the duplex prism.

Any of the zones A–D illustrated in Fig. 3 as well as prismatic bottom zones of the refractor may employ the duplex type prism whenever increased divergence of light incidence from the source or reflector is required or desirable.

What is claimed is:

1. In a street lighting luminaire a light source, a downwardly acting quasi-elliptical reflector about the source with its mouth substantially below the level of the source and oriented with its long axis transverse to the street or roadway and having a generally parabolic contour in longitudinal planes parallel with an angle of 75° to nadir, the axis of said parabola generally making an angle of ten to fifteen degrees to the curb line, and being asymmetrical in vertical planes parallel to the axis of said parabola thus directing vertically divergent light across the mouth of the reflector at high angles above nadir, and a refractor fitted across the mouth of the reflector having an upper region adapted for transmitting the said reflected rays and higher angled direct light toward remote street areas without vertical deviation and in progressively lower regions adapted for intercepting and refracting reflected rays at angles parallel to the higher angled rays transmitted from the upper regions, said refractor having a plurality of substantially horizontal parallel zones of prisms, said zones

being of equal length, the prisms in each zone being substantially parallel with and having substantially equal refracting power as all other prisms in the same zone, the prisms in the uppermost of said zones being vertical and the prisms in said lower zones being inclined from the vertical whereby said prisms in said lower zones are, by virtue of their respective horizontal components, adapted to elevate the light emitted by them, the inclination from the vertical of the prisms in each of said lower zones being such that the vertical deviation imparted to rays transmitted by said prisms is sufficient to elevate said rays into substantial parallelism with the direct and reflected rays transmitted by the upper part of the refractor, so that the entire refractor, when viewed from regions into which the dominant direct and reflected light is directed, is substantially uniformly luminous.

2. A street lighting luminaire as defined in claim 1 wherein at least some of the prisms have a number of flat faces which differ in refractive power one from the other.

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