

United States Patent [19]**Miles**[11] **3,798,445**[45] **Mar. 19, 1974**[54] **TRAFFIC SIGNAL LENS**[75] Inventor: **John R. Miles**, Glenview, Ill.[73] Assignee: **Gulf & Western Industries, Inc.**,
New York, N.Y.[22] Filed: **Feb. 18, 1971**[21] Appl. No.: **116,386**[52] U.S. Cl. **240/106.1, 240/41.4, 340/383,**
350/167[51] Int. Cl. **F21v 5/04, G02b 27/00**[58] Field of Search **240/106.1, 41.4; 350/167;**
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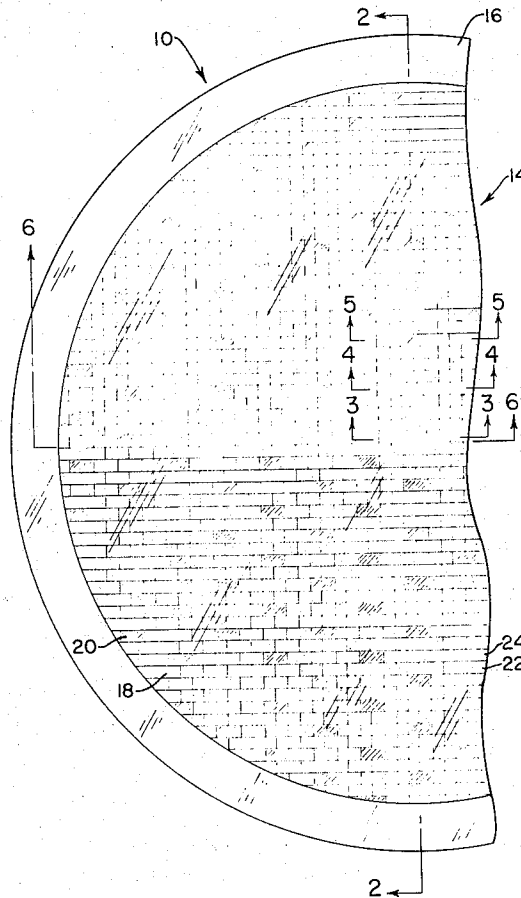
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[57]

ABSTRACT

The invention relates to a traffic light lens preferably formed of polycarbonate material. The inner face of the lens is formed in a mosaic arrangement of rectangular, lenticular areas. The lenticular areas of the lens are of two types, flat areas and curved areas. The curved lenticular areas, which form the greater part of the inner surface of the lens, are curved in both vertical and horizontal directions. The flat areas are tilted to project the light downwardly from the horizontal axis of the traffic light assembly.

12 Claims, 11 Drawing Figures

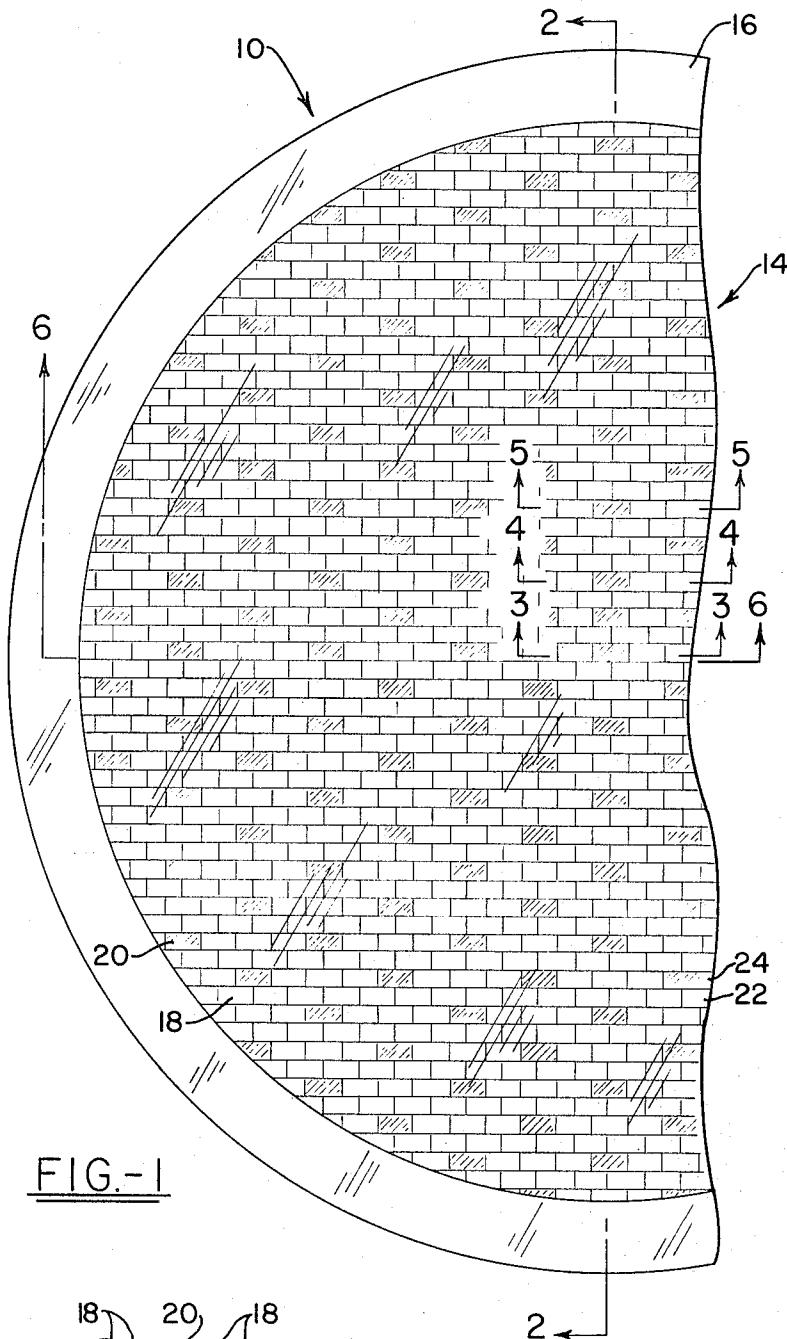


FIG. -1

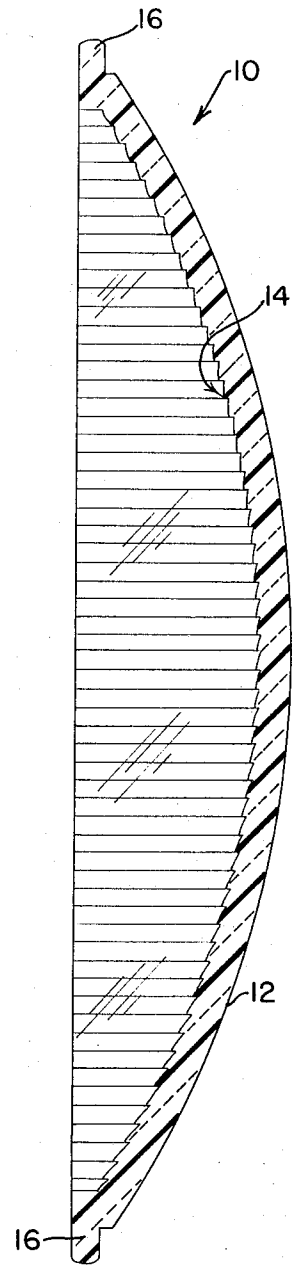


FIG. -2

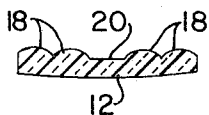


FIG. -3

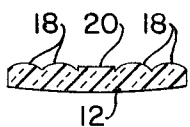


FIG. -4

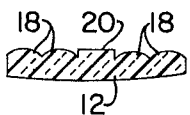


FIG. -5

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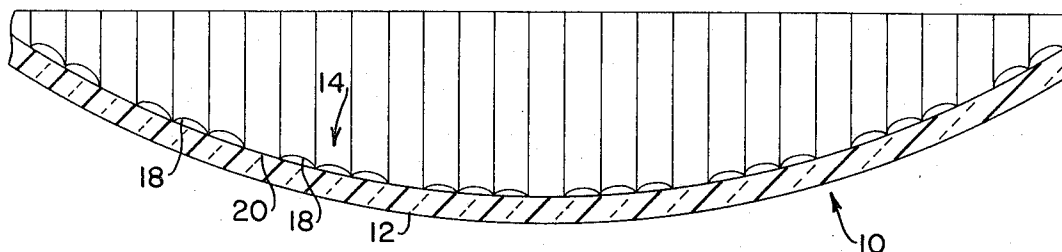


FIG. 6

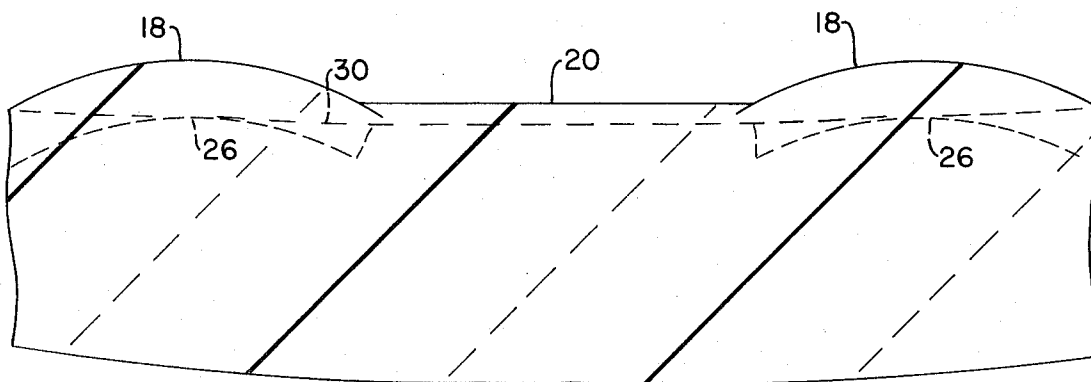


FIG. 7

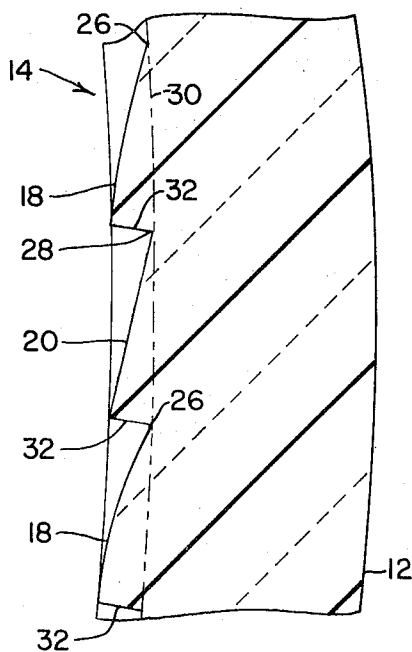


FIG. 8

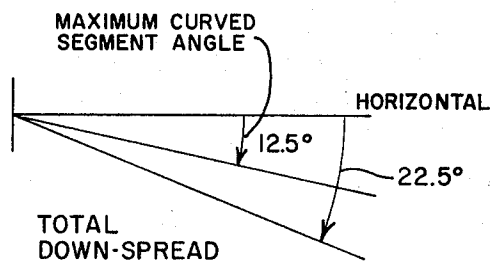


FIG. 9

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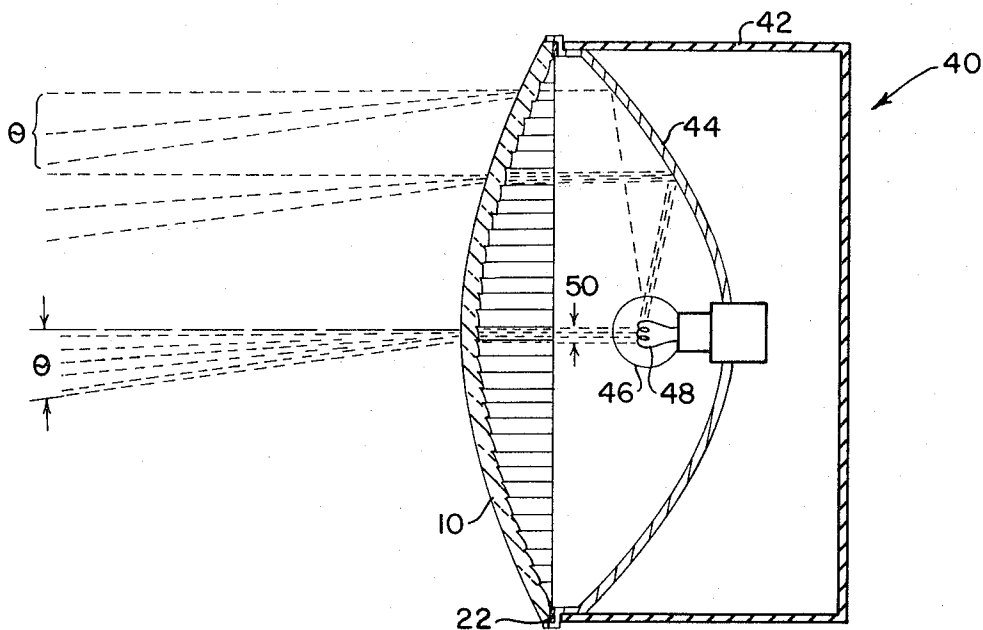


FIG. -10

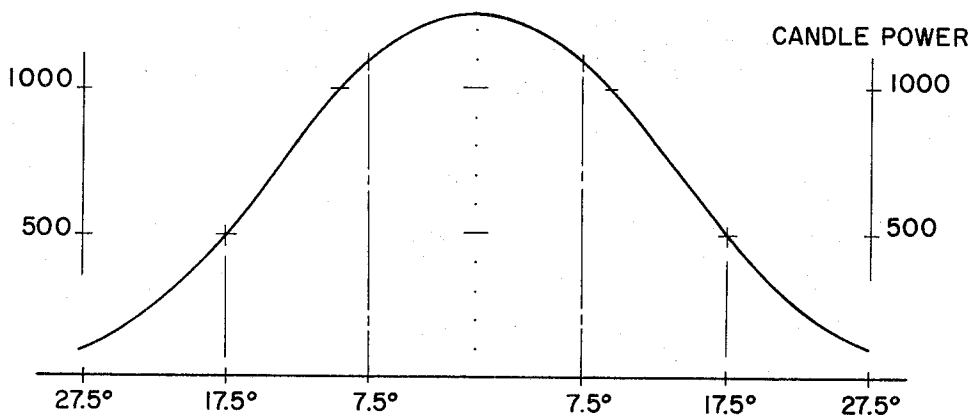


FIG. -11

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TRAFFIC SIGNAL LENS

The present invention relates to traffic signals and more particularly to a lens construction for such signals.

A traffic light consists generally of a number of housings each of which is provided with a parabolic reflector, an incandescent light bulb located at the focus of the paraboloid and a lens or cover which seals the front of the reflector. As is common knowledge, these signals are mounted over the street or sidewalk at an intersection and are operated by suitable control means to regulate the flow of traffic through the intersection. The light is projected through a lens of the signal so that, when it is viewed from the area in front of the signal, the light is clearly visible from the desired locations of the observer, whether he is a pedestrian on the street or a driver of a motor vehicle. For most efficient operation of the signal substantially all of the light projected through the lens should be directed into the desired range of the observer. Since the vehicle driver must be able to see the signal indication from a considerably greater distance from the signal than the pedestrian, a considerably higher degree of illumination must be provided in the center of the range than at its fringes. Maximum efficiency also requires that the light beam be directed slightly downwardly from the horizontal axis of the signal.

Early traffic light lenses were formed of either frosted glass or patterned glass having a more or less random pattern. Such lenses, however, are quite inefficient since there is a considerable scattering of light outside of the desired range and little or no attempt to direct the light beam to provide the desired pattern of illumination. Various arrangements of contoured lenses have been proposed to provide the desired directing of the light beam. Such lenses, however, have been difficult and expensive to manufacture, requiring complex molds. Difficulty has also been experienced in maintaining the desired degree of accuracy in the formation of the lenticular surfaces, thereby reducing the desired degree of accuracy in the formation of the lenticular surfaces, thereby reducing the efficiency of the lens.

The prior lens designs have been intended for either glass or acrylic lenses. Glass lenses are difficult to manufacture, of high weight, and are easily cracked, broken, scratched or damaged. The use of acrylic lenses overcomes some of the disadvantages of the glass lenses. However, acrylic lenses are unable to withstand high temperatures without damage. Serious deformation and loss of color in acrylic lenses has been observed in standard traffic lamps equipped with a 100 watt bulb.

It is the primary object of the present invention to provide a traffic light lens which directs substantially all of the projected light into the viewing range of the observer and which overcomes the deficiencies of prior art glass and acrylic lenses.

It is also an object of the invention to provide a traffic light lens which may be more accurately and efficiently manufactured than previous lenses.

A further object of the invention is the provision of a traffic light lens which is molded of polycarbonate to provide a durable lens capable of withstanding the heat generated by the light bulb of the traffic light assembly.

The above and other objects of the invention which will become apparent in the following detailed descrip-

tion are achieved by providing a lens which has its inner surface formed in a mosaic of substantially rectangular shaped lenticular areas. The majority of these lenticular areas are curved both horizontally and vertically to direct the projected light throughout the desired observation range. The remaining lenticular areas are flat surfaced to direct a portion of the light straight ahead from the signal. All of the lenticular areas are inclined slightly so that the straight ahead light and the light projected through the curved lenticular areas is directed at a small angle downwardly from the horizontal.

For a more complete understanding of the invention and the objects and advantages thereof reference should be had to the following detailed description and the accompanying drawings wherein there is shown a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a fragmentary rear elevation view of a traffic light lens constructed in accordance with the principals of the present invention;

FIG. 2 is a vertical sectional view taken along the line 2—2 of FIG. 1;

FIGS. 3 through 5 are fragmentary horizontal sectional views taken along the lines 3—3 to 5—5, respectively, of FIG. 1;

FIG. 6 is a fragmentary vertical sectional view taken along the line 6—6 of FIG. 1;

FIG. 7 is an enlarged sectional view of a portion of the lens as seen in FIG. 6;

FIG. 8 is an enlarged sectional view of a portion of a lens as seen in FIG. 2;

FIG. 9 is a diagram showing the down spread pattern of the light beam projected through the lens of the present invention;

FIG. 10 is a transverse sectional view of a traffic light housing incorporating the lens of the present invention; and

FIG. 11 is a graph showing a typical horizontal spread pattern of the light projected through the lens.

Referring first to FIG. 10 there is shown a traffic signal projector assembly 40. This assembly is comprised of a housing 42, a parabolic reflector 44 mounted in the housing, a light bulb 46 within the parabolic reflector and with its filament 48 at the focus of the reflector 44, and a lens and cover plate 10 which is sealed at its circumference 22 to the reflector 44 and housing 42. The parabolic reflector 44 serves to direct the light from the filament 48 in a generally horizontal beam and the lens 20 bends or diverts this beam into the desired spread pattern.

The desired horizontal spread pattern is illustrated in FIG. 11, the pattern being shown for a plane inclined downwardly at some predetermined angle such as θ in FIG. 10 where θ normally is $2\frac{1}{2}^\circ$ to the horizontal axis of the projector assembly. It should be understood that while a $2\frac{1}{2}^\circ$ downward inclination is desirable, this angle can vary depending upon the formation of the lenticular areas of the lens as defined more completely hereinafter. FIG. 11 illustrates that the major portion of the projected beam is directed substantially straight ahead along the predetermined downward inclination with an illumination of at least 1,000 candle power being provided in the range of $7\frac{1}{2}^\circ$ on either side of the downwardly directed path. As the observation point is shifted to the right or left of the axis the illumination required decreases so that at $17\frac{1}{2}^\circ$ an illumination of 500 candle power is provided.

The lens 10 designed to achieve the desired spread pattern is illustrated in FIGS. 1 through 9. The lens 10 has a smooth upper surface 12 in the form of a spherical segment, an inner surface 14, and a rim or lip 22. The inner surface 14 of the lens is formed into a plurality of rectangular lenticular areas 18 and 20. The lenticular areas 18 are curved while the areas 20 are flat surfaces. The areas 18 and 20 are preferably arranged in horizontal rows 22 and 24 and cover the entire inner surface 14 of the lens. The lenticular areas of adjacent rows 22 and 24 are staggered or offset relative to one another. Thus, the lenticular areas form a brick-work like or mosaic pattern on the inner surface 14 of the lens. The curved lenticular areas 18 predominate in the lens, as the flat lenticular areas 20 are preferably provided only in alternate ones of the rows and only as every fourth member of such alternate rows. A typical lens may have an overall diameter of 8 $\frac{1}{2}$ inches with the radius of curvature of the outer surface 12 being 7 inches. The individual lenticular areas of such a lens may be approximately 0.25 inches wide and 0.125 inches high. Preferably the lens thickness will be about 0.115 inches.

As will be seen from FIGS. 3 through 8, the curved lenticular elements 18 are curved in both the horizontal and vertical directions. In a typical lens, the horizontal curvature may have a radius of 0.48 inches and the vertical curvature, a radius of 0.25 inches. Also, the curved elements 18 are inclined, with their lower edges being further from the outer surface 12 of the lens than are their upper edges. The flat elements 20 are also inclined in the same manner. Typically, the flat surfaces 20 are inclined from the imaginary spherical surface 30 by an angle of between 2° and 10°, but preferably approximately 5°. The surfaces of these elements 20, however, are flat in both the horizontal and vertical directions. The midpoints 26 of the upper edges of the curved lenticular areas 18 and the midpoints 28 of the upper edges of the flat lenticular areas 20 lie on a common spherical surface concentric with the outer surface 12 of the lens.

The contours of the lenticular elements 18 and the inclinations of these surfaces shown in the drawings are those which provide the desired spread pattern for a polycarbonate lens. The contour of each lenticular area 18 is determined from the consideration of the desired deflection of the projection axis, horizontal axis of the lens and parabola assembly, the desired spread of the projected beam, and the index of refraction of the lens material. The preferable material for forming the lens is polycarbonate. This material, which can be molded into the proper shape, has greater resistance to breakage, scratching and the like than any other material known at this time. The thickness of the lens is chosen for ease of molding, and strength of the part. Polycarbonate is available in standard colors. Obviously, if a different material is used to form the lens or if a different spread pattern is desired, the contours and inclinations of the surfaces of all the lenticular elements will be varied. However, the basic arrangement of employing flat and curved lenticular areas in a mosaic pattern on the lens surface is maintained.

It is contemplated that the lens 10 is formed of polycarbonate by a molding process. The mold for forming the inner surface 14 of the lens may be formed of a stack of steel plates, each plate being of a thickness equal to the height of one row of lenticular areas. Since

all of the curved lenticular areas 18 are of the same contour the mold plates may be formed to the desired contour by the use of an end mill cutter having a rounded or uniform radius contour. Likewise, the mold portions for the flat lenticular areas 20 may be formed on the mold face by the use of end mill cutters with flat end surfaces. This method assures a uniformity of the contours of the lenticular areas throughout the lens as well as substantially reducing the cost of preparing the mold. The lower edges 32 of the lenticular elements are inclined slightly from the horizontal so as to provide sufficient draft to permit the cast lens to be removed from the mold. A typical angle of draft is 3°.

The curved lenticular areas 18 serve both to direct the light downwardly from the horizontal axis of the lens and projector assembly and to direct the light into a diverging pattern to provide adequate illumination within the entire range of an observer of a signal, i.e., a pedestrian or a vehicle near the light and to one side or the other of its axis. The inclination of the curved lenticular areas 18 from the spherical reference 30 provides the downwardly directing action while the curved surface 18 provides for the diverging pattern. The total downspread of the light beam by the curved segments is shown in FIG. 9. The curvature and inclination of the lenticular areas 18 will deflect a light beam parallel to the horizontal downwardly by an angle of 12.5°. Due to the fact that the lamp filament is not a true point light source located at the focus of the paraboloid, an additional spreading of the light beam will result. This can be seen from FIG. 10 when the spread resulting from the filament is indicated at 50. Thus, the maximum downspread from the horizontal through the curved segments or lenticular areas 18 of the lens is 22.5°. The flat lenticular areas serve to direct the portion of the light beam passing through these areas downwardly at a slight angle normally 2 $\frac{1}{2}$ ° from the horizontal and generally in the central portion of the range of an observer of the signal, thus providing the desired higher illumination at the straight ahead position, but still allowing sufficient illumination to occur in side areas.

The lens as described hereinabove will meet the standards set up by the Institute of Traffic Engineers. All of the lenticular elements are tilted to project the light downwardly. Most of the elements, (i.e., the areas 18 of which there are about 10 times as many as the flat areas 20) are curved in both the vertical and horizontal direction, in order to spread the light to a pedestrian; as well as to a motorist; for example, the pedestrian may be located as far as 17 $\frac{1}{2}$ ° below the projector axis of the traffic light. Drivers of vehicles may be to one side of the light, as may be pedestrians and therefore areas 18 are curved in the horizontal plane as well.

Further, while only an approximate 8-inch diameter lens has been described in detail, it should be understood that the principles are applicable to a 12-inch lens, or any other diameter lens as well. Specifically, with respect to a 12-inch lens, some slight dimensional changes appear appropriate to compensate for the larger and hence somewhat flatter design, as follows:

Outer lens surface formed on a radius of 16.700 inches

Inner lens surface formed on a radius of 16.450 inches

Curved lens — horizontal radius of 0.217 inches

Curved lens — vertical radius of 0.477 inches

3° draft on lens segments

Curved lens segments 0.250 wide × 0.125 high

Flat lens segments 0.250 wide × 0.125 high

Same ratio of flat to curved as 8-inch lens

Lens thickness about 0.115 inches

Flat and curved lens horizontal inclination = 5°

While only the best known embodiment of the invention has been described and illustrated in detail, and while specific angles and degrees of inclination have been described with reference to the preferred embodiment, the invention is not so limited. Reference should be had to the appended claims in determining the true scope of the invention.

What is claimed is:

1. A lens for a traffic light signal, comprising:
a body portion in the form of a spherical segment;
a mounting rim at the periphery of the body portion;

a plurality of first lenticular elements formed on one surface of the body portion, the first lenticular elements being curved in both the horizontal and vertical directions; and

a plurality of second lenticular elements formed on the one surface of the body portion, the second lenticular elements being flat;

the first and second lenticular elements covering substantially the entire one surface of the body portion in non-overlapping relation to one another.

2. The lens according to claim 1 wherein all the lenticular elements are rectangular, the elements being arranged in rows extending horizontally across the body portion of the lens.

3. The lens according to claim 2 wherein the lenticular elements of adjacent rows are staggered.

4. The lens according to claim 2 wherein said second lenticular elements are provided only in alternate ones of the rows of elements, and at spaced intervals therein with said first elements between said second elements.

5. The lens according to claim 4 wherein there is a greater number of said first lenticular elements than second lenticular elements, and said lens is made from

a polycarbonate material.

6. The lens according to claim 5 wherein the lenticular elements are tilted so as to direct a light beam downwardly at a slight angle from the horizontal, and said elements are formed on the concave inward surface of said lens.

7. A traffic light signal lens having a smooth outer surface and an inner surface formed into a plurality of horizontally parallel rows of lenticular elements, the lenticular elements being of two types, the first type of lenticular elements being curved in both the horizontal and vertical directions and the second type of lenticular elements being flat.

8. The lens according to claim 7 wherein the lenticular elements are rectangular, having a greater length than height.

9. A traffic light signal lens having a smooth outer surface and an inner surface formed into a plurality of lenticular elements, the lenticular elements being of two types, the first type of lenticular elements being curved in both the horizontal and vertical directions and the second type of lenticular elements being flat, both said types of lenticular elements being rectangular and having a greater length than height, and said lenticular elements being arranged in horizontally extending rows with the elements of adjacent rows being offset in a brick-work like pattern.

10. A traffic light signal lens having a smooth outer surface and an inner surface formed into a plurality of lenticular elements, the lenticular elements being of two types, the first type of lenticular elements being curved in both the horizontal and vertical directions and the second type of lenticular elements being flat, said lenticular elements being tilted to provide a maximum point of illumination along an axis inclined by an angle of between 1° to 10° from the horizontal.

11. The lens according to claim 10 wherein the lens is molded of a polycarbonate material.

12. The lens according to claim 11 wherein each lens is formed with a tapered edge surface to permit molding of the lens from said polycarbonate material.

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