

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11)

Publication number:

0 251 154
A2

(12)

EUROPEAN PATENT APPLICATION

(21)

Application number: 87109011.4

(51)

Int. Cl.4: **F21P 1/00**

(22)

Date of filing: 23.06.87

(30)

Priority: 23.06.86 US 877618

(43)

Date of publication of application:
07.01.88 Bulletin 88/01

(54)

Designated Contracting States:
BE DE ES GB IT NL SE

(71)

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Projector floodlight lighting system.

(57)

An improved lighting system for tennis courts, baseball fields and football fields and similar applications is disclosed. Fixed-aim floodlights provide rectangular normally horizontal patterns of illumination. The floodlight lamps are maintained vertically to maintain maximum efficiency. Each floodlight is also provided with a reflector for redirecting light rays from the lamp and a refractor having on its upper part a steep parabolic surface having a reflective metalized surface and prisms for redirecting the reflected light rays laterally.

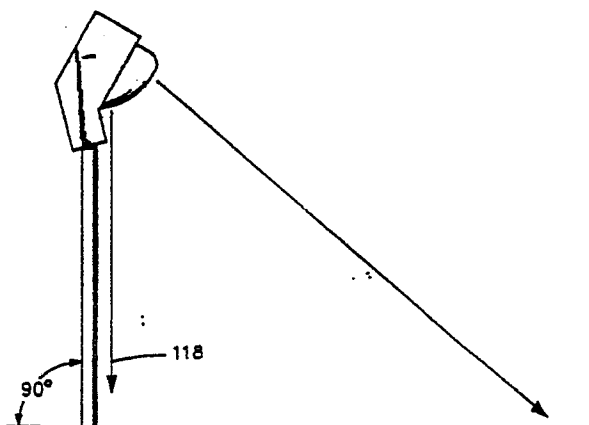


FIG.2A

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Projector Floodlight Lighting System

Background of the Invention

This invention relates to a lighting system and more particularly to a lighting system for baseball fields, tennis courts, football fields and other similar applications.

In lighting systems of the prior art for baseball fields, tennis courts and football fields and the like illumination of the field is accomplished by aiming floodlights at different spots on the field whereby there is created on the field a mosaic of spots of light illuminating the field. This procedure naturally requires the aiming of each floodlight by the tilting of the lamp which not only requires on the spot mechanical adjusting but the tilting also reduces the output of metal halide lamps and prevents the use of super metal halide lamps which need to be operated vertically or horizontally.

Summary of the Invention

In order to overcome the disadvantages of the prior art and to provide a lighting system for sports applications and the like which simplifies maintenance, has increased efficiency, eliminates the need for aiming and reduces the number of floodlights required to achieve the same results by 20-40%, there is provided by the subject invention a lighting system for sports applications and the like utilizing fixed-aim floodlights employing essentially vertically mounted metal halide lamps (within $\pm 5^\circ$) tilt or vertically mounted super metal halide lamps to produce substantially rectangular light patterns.

Accordingly, it is an object of the present invention to provide a more efficient lighting system which not only requires 20 to 40% fewer floodlamps but is more power efficient and simpler to maintain.

Another object and advantage of the present invention is that when one lamp fails there is no dark area since the illumination is spread over a greater area.

Another object and advantage of the present invention is to spread the light source to a larger area thereby making it easier for someone to look up at the floodlamp from the area being illuminated.

These and other objects and advantages of the invention will become apparent from a review of the specification and drawings and from a study of a preferred embodiment which is given by way of illustration only.

Brief Description of the Drawings

Figure 1A illustrates a lighting system of the prior art in which floodlights mounted in clusters on poles are aimed at different spots on a baseball field creating a mosaic of spots of light lighting the field.

Figure 1B illustrates a lighting system according to the present invention in which rectangular shaped normally horizontal light patterns perpendicular to the lamp axis of the luminaire are produced by fixed aim floodlights employing vertically mounted lamps to light a baseball field.

Figure 2A is a side view of a floodlight luminaire illuminating a rectangular shaped area where the plane of the rectangular area is horizontal and perpendicular to the lamp axis of the luminaire.

Figure 2B is a plan view of the floodlight luminaire of Figure 2A illuminating a rectangular shaped area where the plane of the rectangular area is horizontal and perpendicular to the lamp axis of the luminaire.

Figure 3A is a side view of a floodlight in which the lamp is tilted 25° having a reflector adapted to produce a rectangular horizontal light distribution pattern.

Figure 3B is a plan view of the light distribution of the floodlight illustrated in Figure 3A.

Figure 4A is a side view of a floodlight in which the lamp is mounted essentially vertically employing the same reflector as illustrated in Figure 3A.

Figure 4B illustrates the light distribution achieved by the floodlight shown in Figure 4A.

Figure 5A illustrates that the floodlight of Figure 4A provides insufficient illumination of the corners closest to the luminaire.

Figure 5B illustrates that with the floodlight of Figure 4A too much light goes above the 90° axis of the lamp.

Figure 6 illustrates a prismatic glass refractor that redirects light into the corners closest to the luminaire of the desired light pattern while reducing the direct light emitted above the 90° axis of the lamp.

Figure 7 is a cross-sectional view taken along line A-A of Figure 6.

Figure 8 illustrates the prism effect of corners allowing reflected light rays to split to opposite directions.

Figure 9 illustrates the shape of the lower portion of the refractor shown in Figure 6.

Figure 10 is a cross-section of the refractor taken thru I in Figure 9.

Description of the Preferred Embodiment

As illustrated in Figure 1A in lighting systems of the prior art for baseball fields, tennis courts and football fields and the like, illumination of the field 10 is accomplished by aiming floodlights (not shown) mounted in clusters for example on poles 12 which are aimed by tilting and create illumination patterns 14 producing a mosaic of spots of light which illuminate the field 10.

As illustrated in Figure 1B in accordance with the present invention, the illumination of a field 110 is accomplished by mounting fixed-aimed floodlights (not shown) in clusters on poles 112, the floodlights producing rectangular light patterns 114 which may be overlapped for greater light intensity. An advantage of the spread light source of the present invention is that when one lamp fails there is no dark area as there would be in the prior art and also it is less blinding to the observer looking up at a cluster of floodlights than with lamps each directed to one spot. Thus a player or fan viewing the cluster of floodlights sees the cluster as uniformly bright --not one very bright light in the midst of other less bright or even dark lights.

With the use of fixed-aimed floodlights the present invention not only avoids the necessity of aiming the lamps on site but also provides for floodlights in which the lamp is maintained essentially in a vertical position thus providing the greatest efficiency when utilizing a metal halide lamp and a necessity when using a super metal halide lamp.

A metal halide lamp loses output as a nonlinear function of tilt from the vertical for example:

0° - 1.00
15° - .94
30° - .93
45° - .90
60° - .88
75° - .87
90° - .94

It is thus seen that the greatest efficiency and output for a metal halide lamp is when it has 0° tilt. The present invention also provides for the use of super metal halide lamps which are more efficient than metal halide lamps and can only be operated vertically or horizontally.

As illustrated in Figures 2A and 2B the purpose of the floodlight generally identified by the reference numeral 116 in the present invention is to illuminate a rectangular shaped area 114 (see also Figure 2B) where the plane of this normally horizontal area is perpendicular to the lamp axis 118 of the luminaire. Thus with the desired light pattern to be rectangular the optimum burning position of the lamp is to be perpendicular to the light pattern.

As illustrated in Figure 3A the design of the reflector 120 generates a rectangular light pattern 114 for a floodlight generally identified by the numeral 122. However, in Figure 3A the floodlight 122 has a lamp 124 which is tilted 25° toward the light pattern and the floodlight of the present invention is not intended to be aimable by tilting the luminaire towards the light pattern. Thus as illustrated in Figure 4A this results in a position with the plane of the opening of a reflector 220 of a luminaire generally identified by the reference numeral 216 at a 25° tilt towards an area 214 to be illuminated (25° with respect to the lamp 224 axis.) This does not allow the distribution of the direct light from the luminaire 216 to coincide with its reflected light distribution as shown in Figures 3A and 3B. As a result, the reflected light distribution is projected closer to the luminaire as illustrated in Figure 4B.

While this total light distribution would be sufficient, limitations on hydroforming reflectors require generous radii in the corners created by two adjacent sides intersecting. The generous corner radii reduces the amount of light being emitted from the floodlight 216 by reducing the angle of the emitted light resulting in reduced illumination levels in the corners closer to the luminaire of the desired light pattern as illustrated in Figure 5A.

As illustrated in Figure 5B too much light is going above the 90° axis of the lamp due to the restricted bearing position of the lamp 224 (vertical). As shown in Figure 5B approximately 45% of the bare lamp lumens are emitted above this axis.

Figure 6 illustrates a prismatic glass refractor generally identified by the reference numeral 226 which redirects light into the corners closest to the luminaire of the desired light pattern while reducing the direct light emitted above the 90° axis of the lamp 224.

Since the direct light emitted above the axis is unfavorable in this present direction it should be redirected towards the area to be illuminated and even more favorable if it could be redirected to an area that was insufficient in desired illumination levels i.e. the corners of the desired rectangular light pattern closest to the luminaire.

Since the laws of physics will not allow us to refract the light that much it must be reflected. Various means of reflection can be used to achieve this goal, one is an exterior metal reflector. However, while this could adequately do the job it would be costly in tooling costs and labor costs. The least costly approach is to apply a reflective surfacer directly to the refractor whose shape and contour allow for optimum redirection of the light while reducing or eliminating excessive costs. The refractor 226 has on its upper part a steep second surface S₂ designed in the longitudinal cross sec-

tionas a parabolic surface. A reflective metalized surface is applied to the surface S_2 to reflect light rays being emitted from the lamp. With the refractor 216 in its proper design application these light rays O_1 are theoretically reflected to the 0 degree axis of the lamp. With the S_2 surface receiving light from the entire light source the spreading of the light O_2 will allow the light to fill vertically across the areas of the desired light pattern. Multiple surfaces or prisms 230 are formed on the S_2 surface each of which is designed specifically to interact the surface with the inner surface S_1 to properly redirect laterally the reflected light rays. (See Figure 7)

Since the refractor 226 must enclose the lamp 224 from the environment the reflected light rays must enter and exit the lower portion of the refractor 226 through the inner surface S_3 and the outer surface S_4 on its way to the desired location. With the reflected light rays intercepting the S_3 and S_4 surfaces of any point from one side at the flange of the refractor to the other side transition in contour change must be smooth. No corners can intercept the reflected light rays. This is because corners create a large prism effect allowing the reflected light rays to split to opposite directions illustrated in Figure 8. The corners are defined as small radii, less than one inch, connecting two separate surfaces. This semi-domed area shown in Figures 9 and 10 will intercept all the reflected light rays and will not interfere and deviate the light rays on the way to the desired location. The transition between the reflective surface S_2 and the semi-domed area S_4 and S_1 to S_3 must be smooth with a large radii to allow for unimpeded flow of glass during manufacturing. This transition area does not intercept any reflected light from S_1 therefore this corner area does not interfere with the design theory.

From the foregoing it can be seen that there has been provided by the subject invention a new and improved lighting system for baseball fields, tennis courts and football fields and the like which eliminates the need for aiming, reduces the number of floodlights required to achieve the same results by 20-40% and simplifies maintenance. It should also become apparent that many changes may be made in the floodlight without departing from the spirit and scope of the invention. The preferred embodiment of the invention has been shown by way of illustration only. Having described our invention:

Claims

1. A lighting system for lighting tennis courts, baseball fields and football fields and the like comprising a plurality of fixed-aimed floodlights for pro-

ducing generally rectangular light patterns, the floodlights being so positioned that a desired light intensity is obtained.

2. A lighting system as defined in Claim 2 wherein said floodlight has a lamp which is mounted essentially vertically.

3. A lighting system as defined in Claim 2 wherein said lamp is a metal halide lamp.

4. A lighting system as defined in Claim 2 wherein said floodlight has a super metal halide lamp mounted therein.

5. A fixed-aim floodlight for producing a rectangular pattern of light comprising a vertically mounted lamp, a reflector positioned behind said lamp for reflecting light emitted from the back of the lamp to said desired rectangular pattern of light and a refractor for redirecting light into the corners of the rectangular pattern.

6. A fixed-aim floodlight as defined in Claim 5 wherein said refractor has on its upper part a steep surface designed in longitudinal cross section as a parabolic surface.

7. A fixed-aim floodlight as defined in Claim 6 wherein said steep surface on the upper part of said refractor has an outer surface which has a reflective metalized coating thereon.

8. A fixed-aim floodlight as defined in Claim 7 wherein a multitude of prisms are formed in the outer surface of the upper part of the refractor under the reflective metalized coating and are designed to interact with the inner surface of the upper part of the refractor to properly redirect laterally reflected light rays.

9. A fixed-aim floodlight as defined in Claim 7 wherein the refractor has a lower portion which is designed so that it will not interfere and deviate reflected light rays on the way to a desired location.

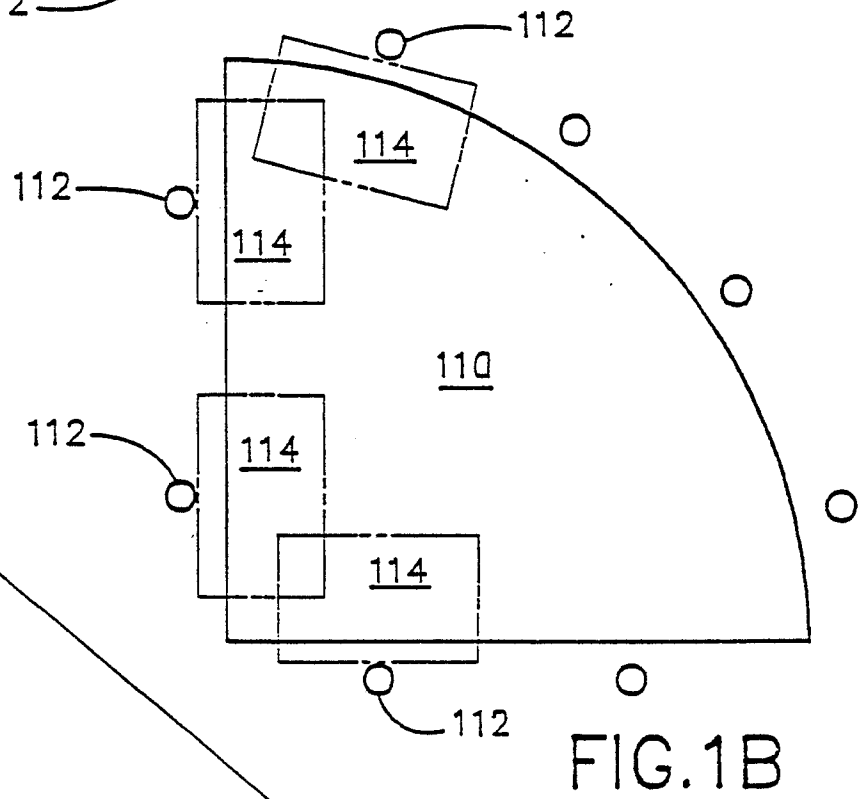
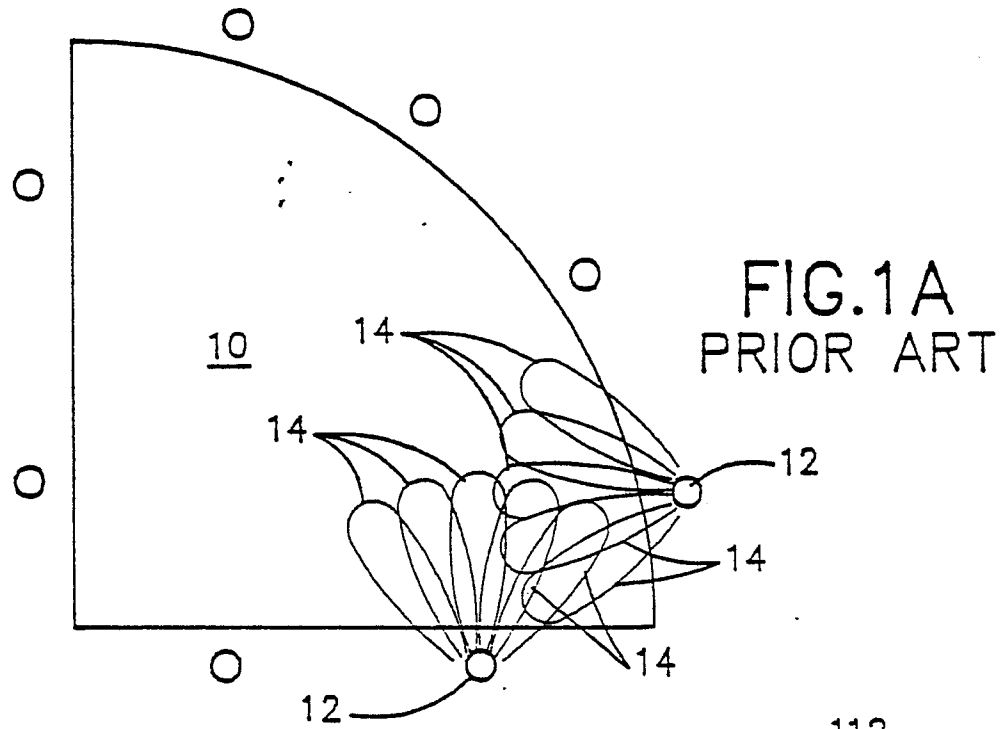


FIG. 2A

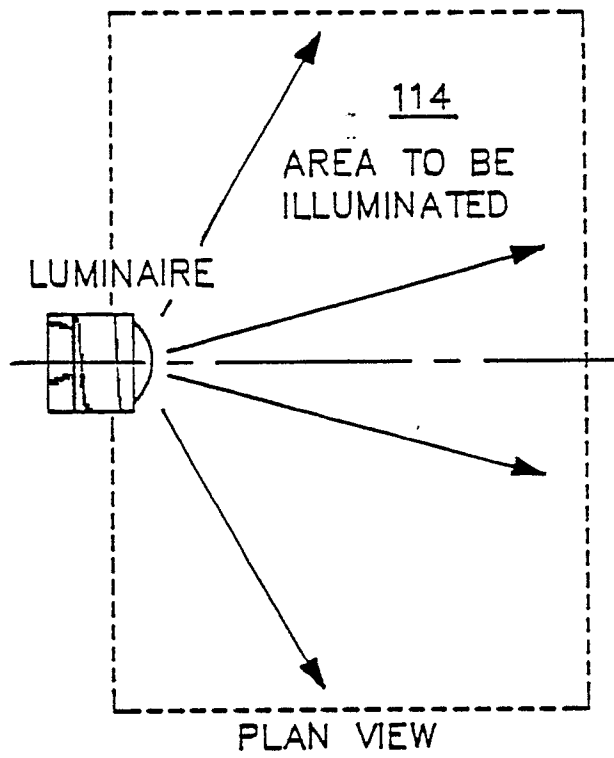


FIG. 2B

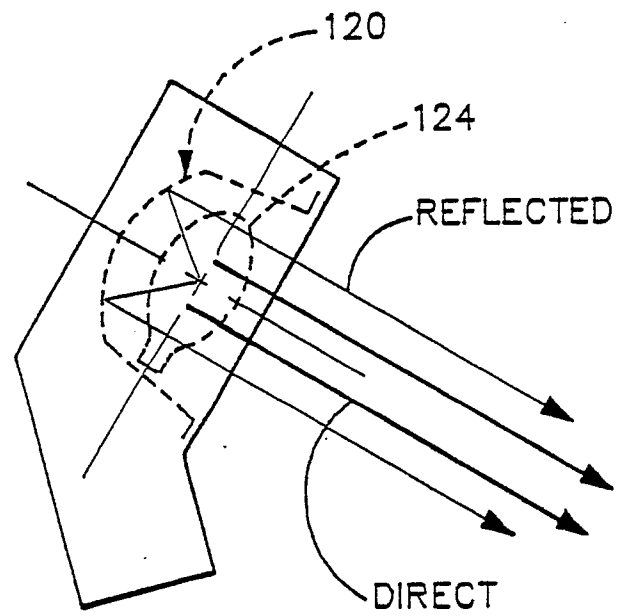


FIG. 3A

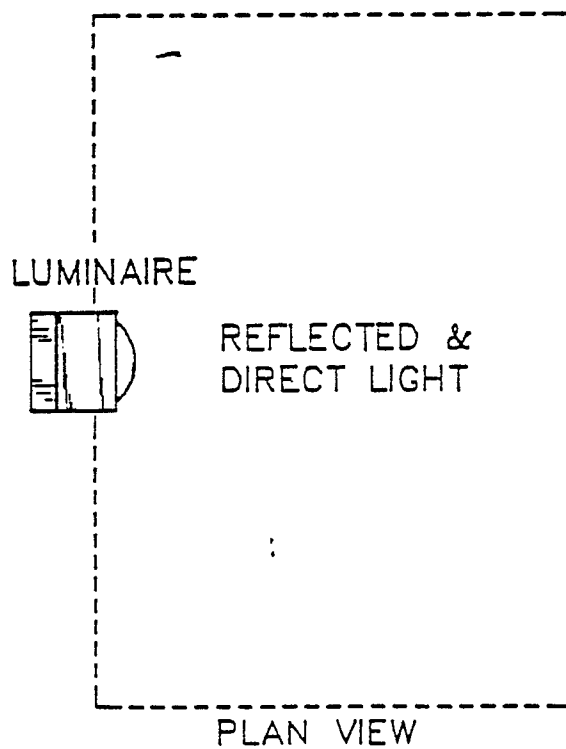


FIG. 3B

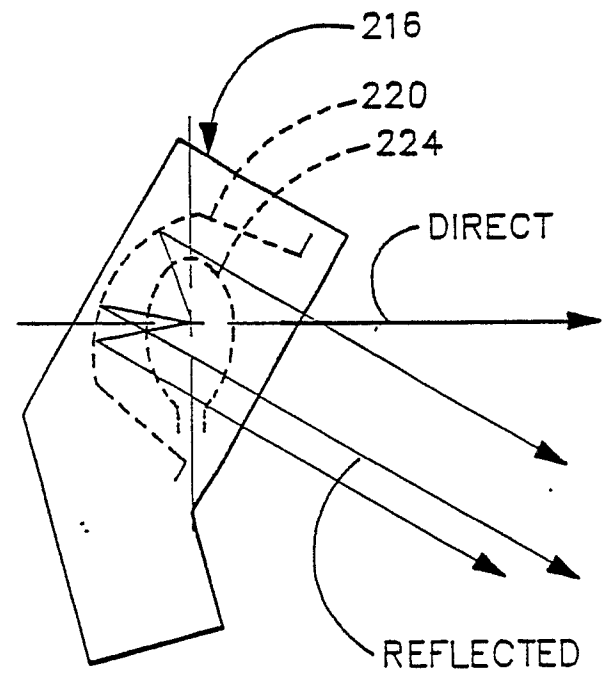


FIG. 4A

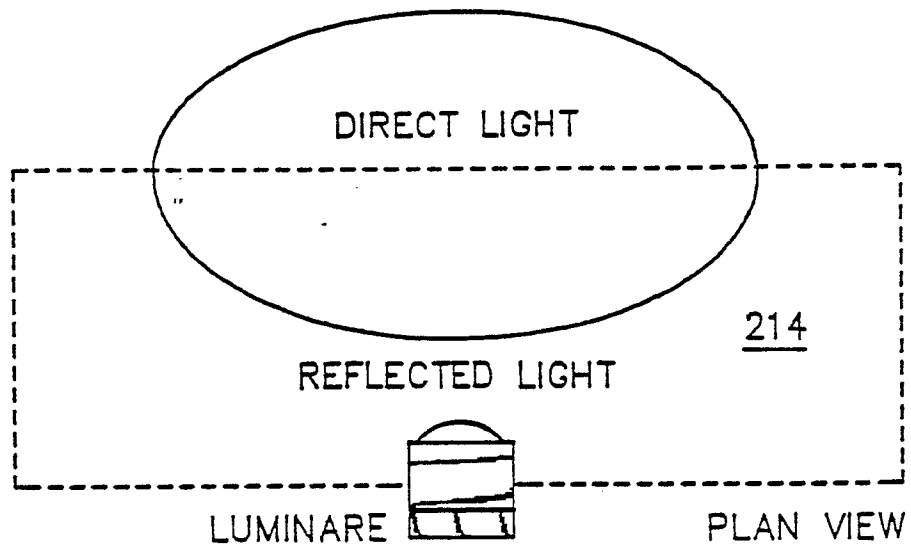


FIG. 4B

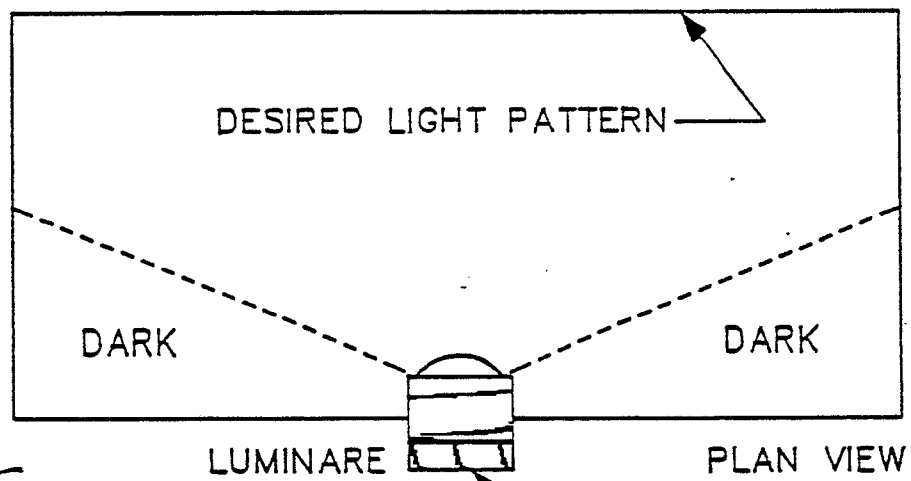
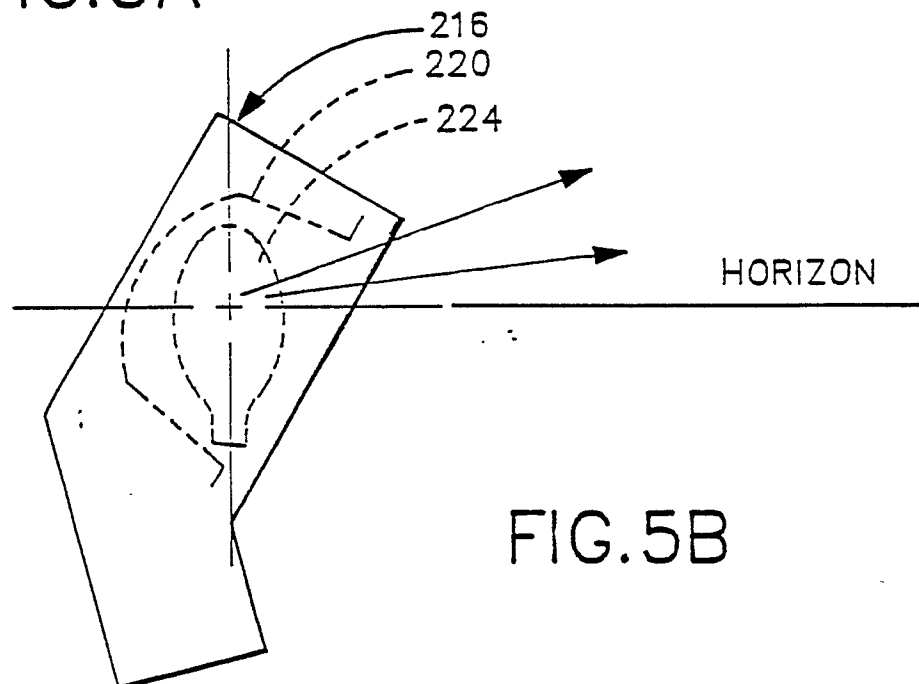
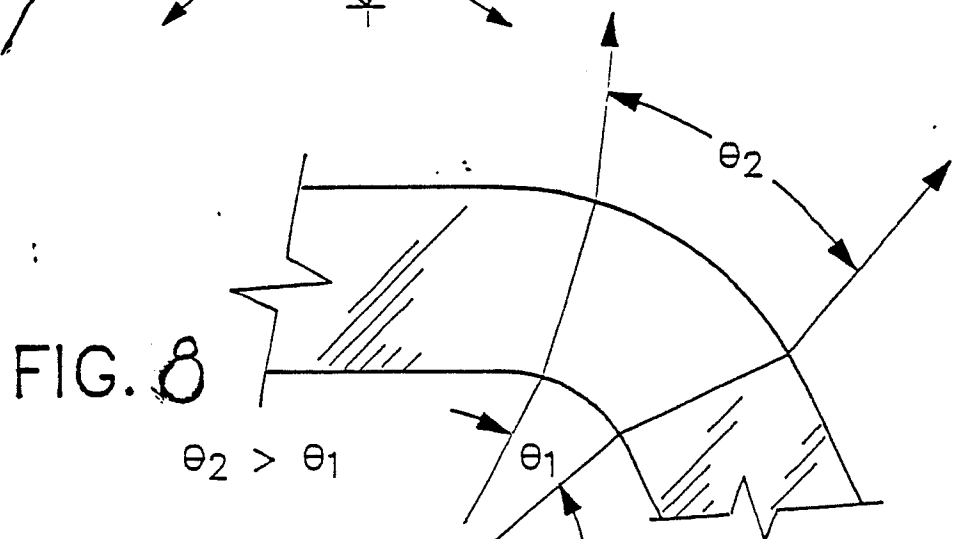
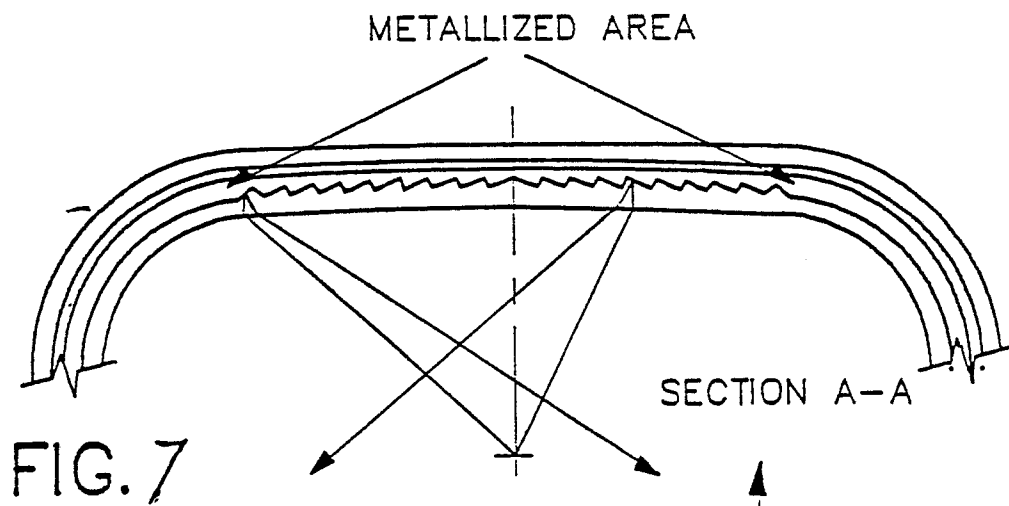
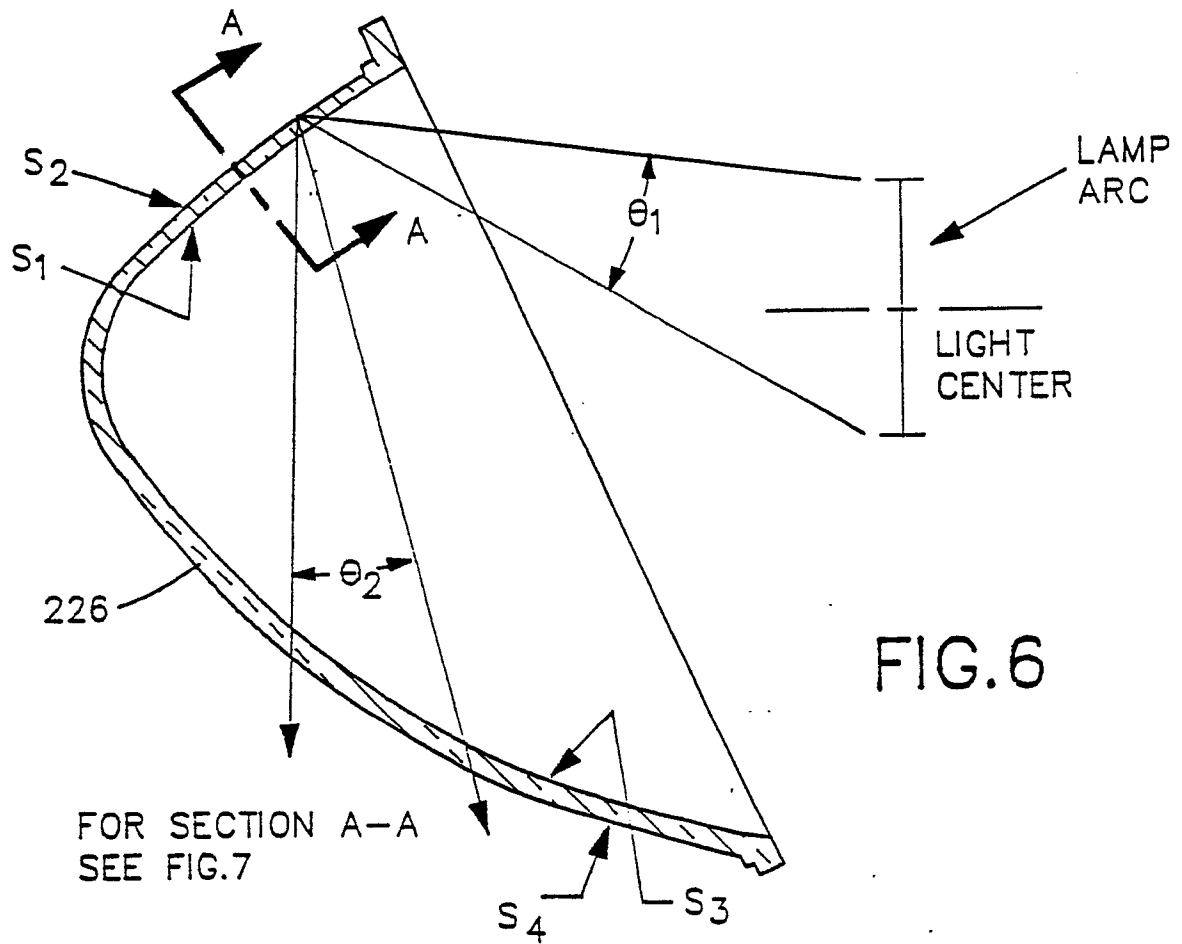


FIG. 5A





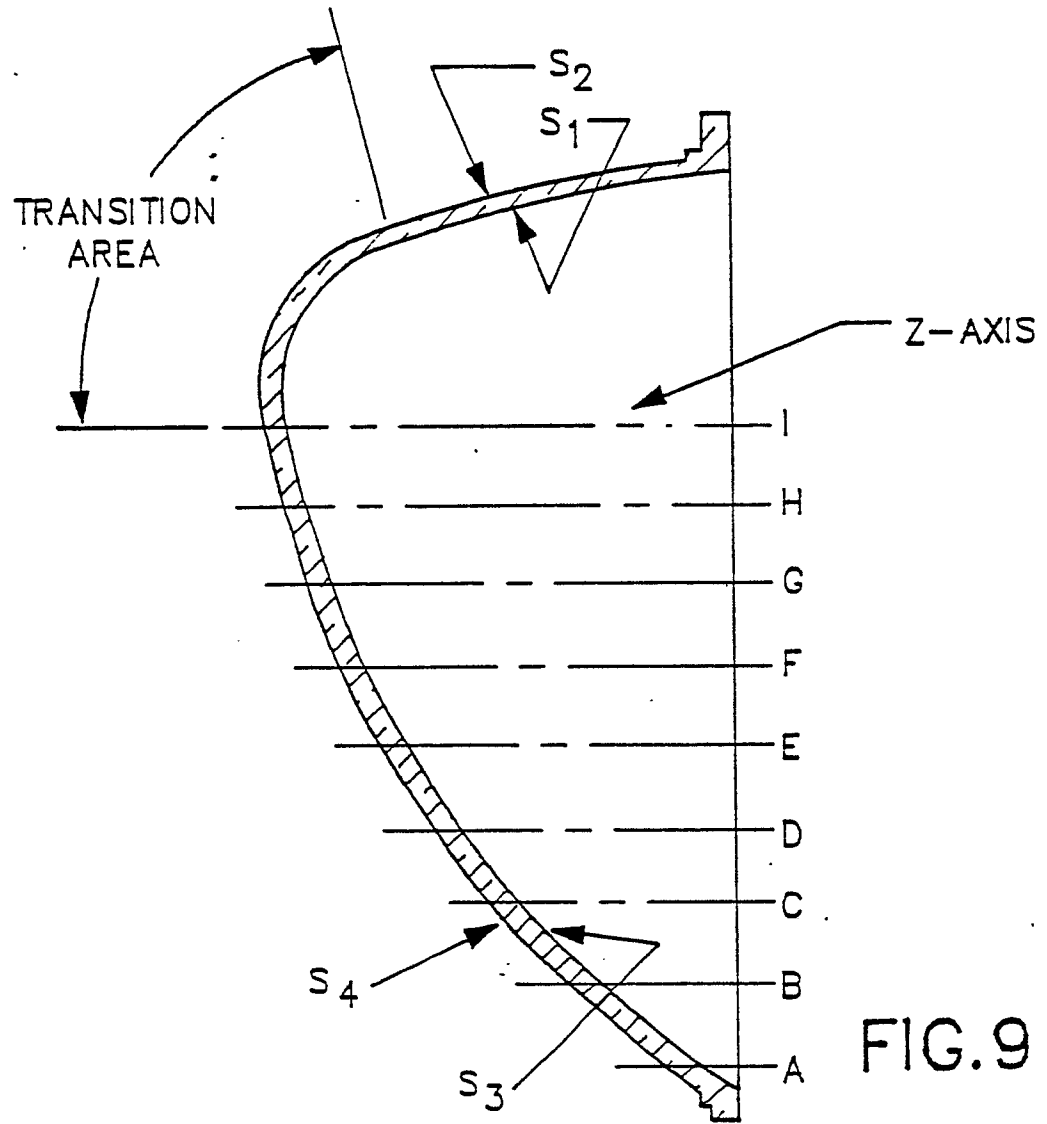


FIG. 9

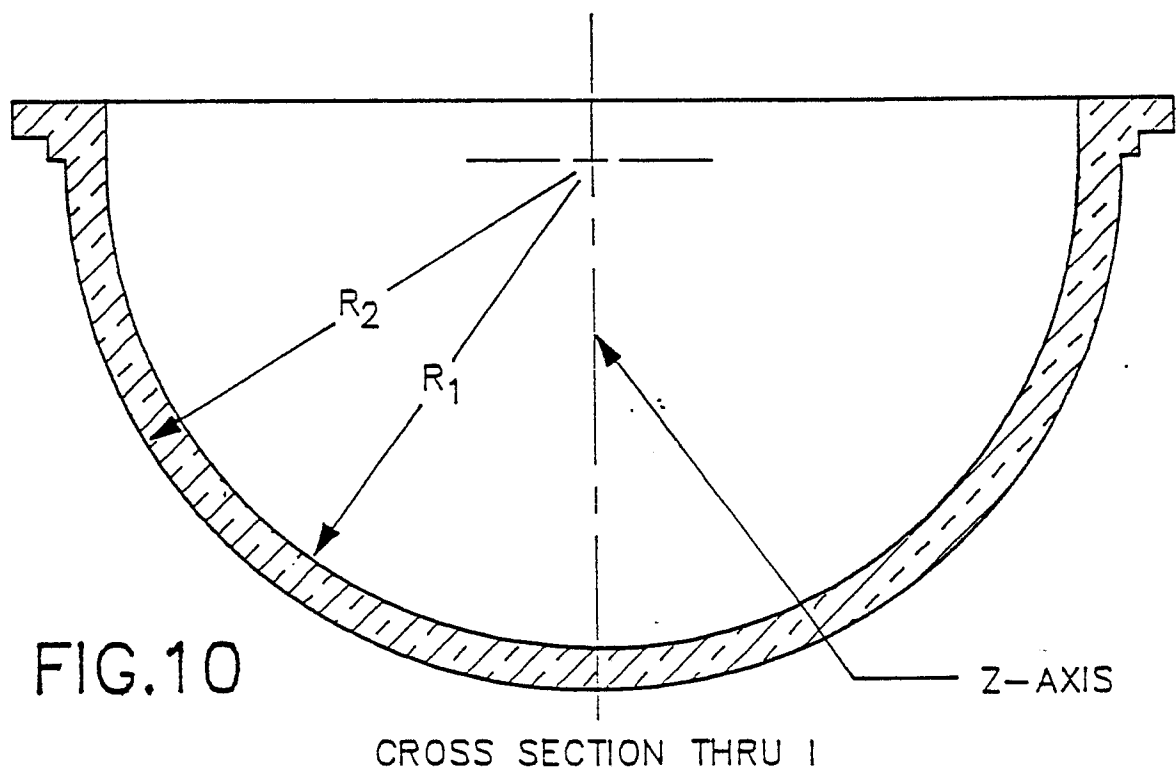


FIG. 10