United States Patent [19]

Freeman

[11] **3,835,342**

[45] **Sept. 10, 1974**

[54] **RADIANT ENERGY COLLECTOR OR REFLECTOR**

[75] Inventor: **Miller L. Freeman,** Burbank, Calif.

[73] Assignee: **John W. Ervin,** Beverly Hills, Calif. ; a part interest

[22] Filed: **May 21, 1973**

[21] Appl. No.: **361,955**

[52] **U.S. Cl.** .... **313/114,** 240/41.35 C

[51] **Int. Cl.** **H01k 1/32**

[58] **Field of Search** .... 313/113, 114; 350/301, 350/305, 306; 240/41.35 R, 41.35 C, 41.35 D, 41.38 R, 41.38 A

[56] **References Cited**

UNITED STATES PATENTS

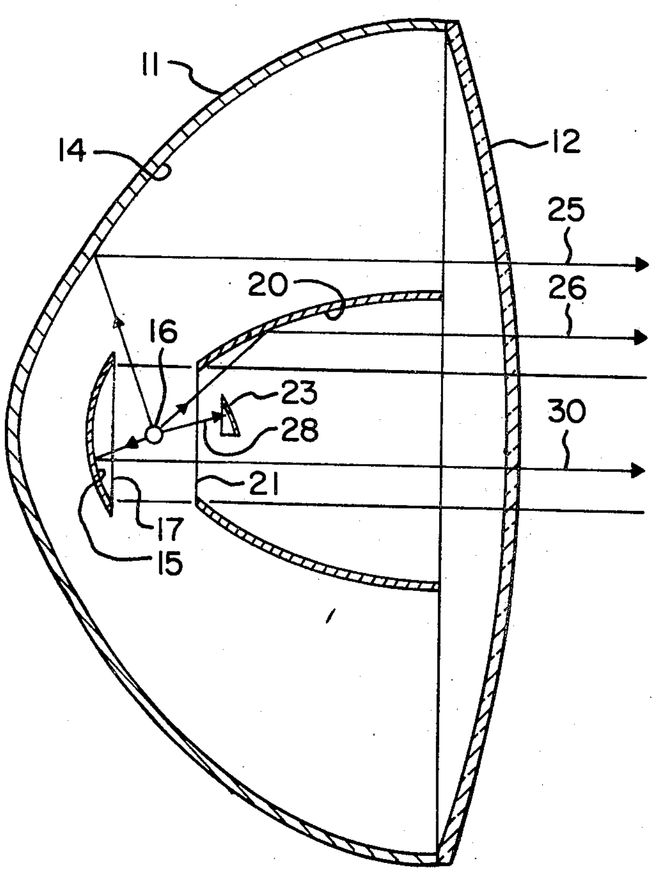
575,473	1/1897	Fuller	240/41.35 R X
1,625,946	4/1927	Laird	240/41.35 R
1,880,399	10/1932	Benjamin	240/41.35 R
2,084,245	6/1937	Irujo	240/41.35 D
3,038,372	6/1962	Lessman	240/41.35 R X
3,184,591	5/1965	Cibie	240/41.35 C

Primary Examiner—Alfred L. Brody
Attorney, Agent, or Firm—Edwin A. Oser

[57] **ABSTRACT**

A light projector particularly suitable for automobile headlights which will direct a plurality of concentric light beams of different intensities substantially without energy loss. The light projector is provided with a stepped rear reflector of parabolic shape or partially or entirely of the shape of an anamorphosscope. It also is provided with a first front reflector of parabolic shape and a second front reflector disposed inside of the first front reflector of substantially spherical shape. The first front reflector may also be partially or entirely of the shape of an anamorphoscope corresponding to that of the rear reflector. The second front reflector substantially obscures the light source from an observer above a predetermined plane such as a horizontal plane. This will minimize the danger of glare to an approaching driver. On the other hand it will direct substantially all of the light onto the road and permit the beam to reach farther out with the same amount of candle power. The projector may also be used to direct any radiant energy such as electromagnetic waves or sound waves. Additionally it may be used not only to reflect or project radiant energy but also for collecting radiant energy into a focal point.

9 Claims, 8 Drawing Figures



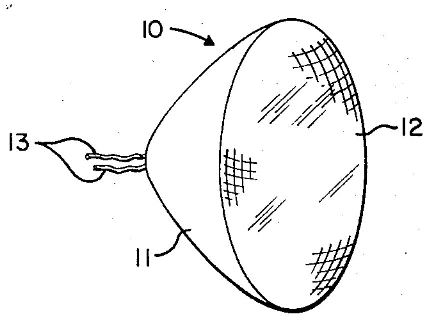


Fig. 1

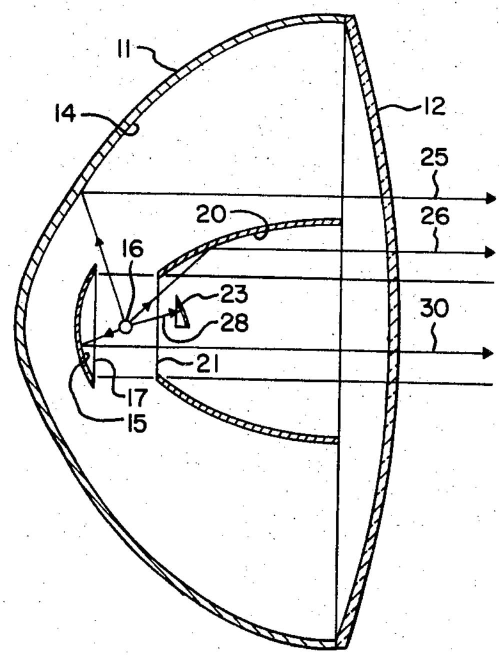


Fig. 2

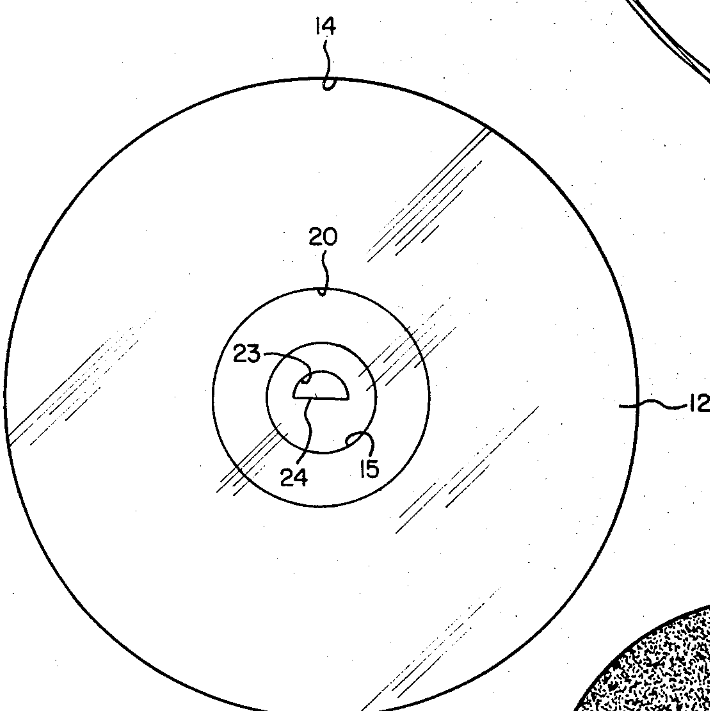


Fig. 3

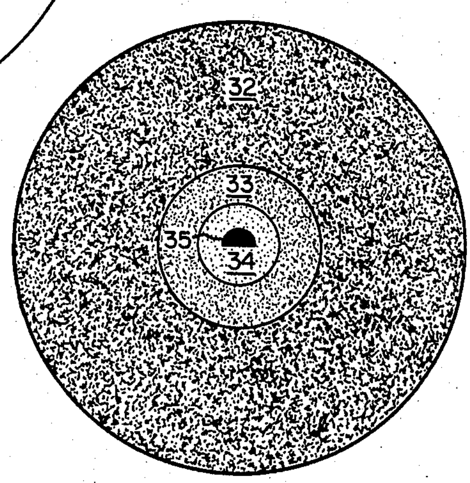


Fig. 4

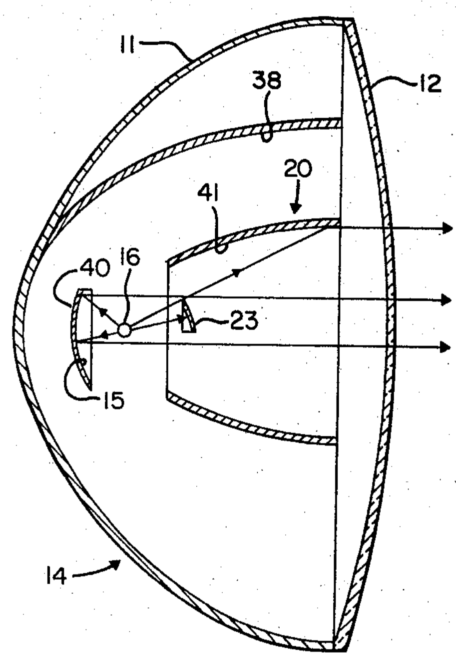


Fig. 5

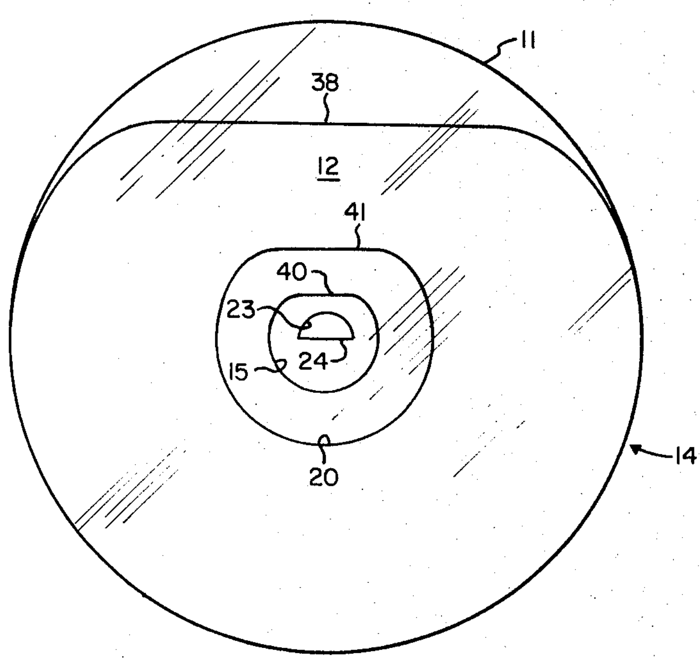


Fig. 6

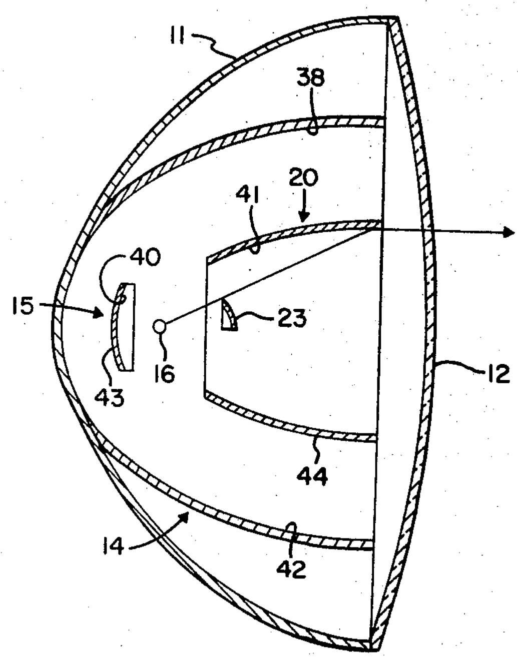

11
38
41
20
40
15
23
16
43
12
44
14
42

Fig. 7

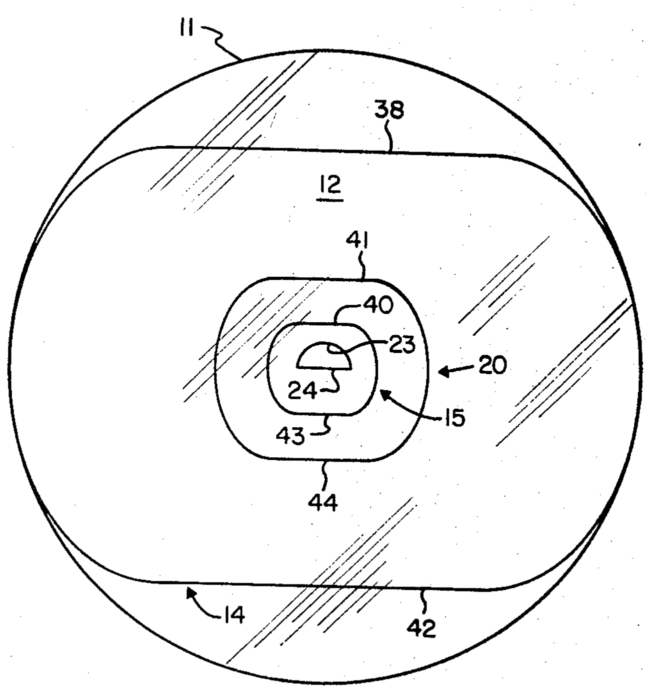

11
38
12
41
40
23
20
24
15
43
44
14
42

Fig. 8

RADIANT ENERGY COLLECTOR OR REFLECTOR

BACKGROUND OF THE INVENTION

This invention relates generally to radiant energy collecting or reflecting systems and particularly relates to a light beam projector which directs the light so as to provide a plurality of concentric focused beams with substantially no diverging light or substantially without loss of energy.

It is well known that light projectors such as automobile headlights may cause considerable glare to practically blind the driver of an approaching vehicle. It is also known that this may cause accidents. Furthermore, such light projectors are inefficient because the light energy that is directed upwards is completely wasted.

Various attempts have been made in the past to minimize the danger caused by the light beam of a projector being directed in an undesired direction. Thus, it has been proposed to absorb the light which is normally directed in an upward direction. As a result this light energy is transformed into heat. The generation of heat is particularly detrimental for the sealed beam headlights of a car because the sealed space of the headlights is not easy to cool.

It is accordingly an object of the invention to provide a light projector capable of improving the vision of a driver of a vehicle so equipped and to avoid impairing of the vision of a driver of an oncoming vehicle.

A further object of the present invention is to provide a radiant energy projector which substantially wastes none of the radiant energy but directs it into a desired direction such as onto the road and obscures the light source from an observer above a predetermined plane.

Another object of the invention is to provide improved apparatus for either collecting or reflecting radiant energy while minimizing energy losses.

SUMMARY OF THE INVENTION

This is accomplished in accordance with the present invention by a specially shaped and stepped rear reflector and a pair of front reflectors for a radiant energy source such as a light source. It will be realized that radiant energy reflectors do not have the undesirable chromatic aberration which is inherent in any radiant energy refractors. Since the light reflecting system of the present invention does not utilize refractors the apparatus of the present invention can be used effectively over the entire electromagentic wave spectrum. Accordingly, it can be used not only for visible light, but infrared or ultraviolet light as well as other regions of the electromagnetic spectrum. Furthermore, it may be used for any radiant energy including, for example, sound energy.

It will also be understood that the apparatus of the present invention need not be used only for projecting radiant energy but may be used equally well for collecting or receiving the radiant energy and concentrating it into a focal point.

Specifically, the apparatus of the present invention for collecting or reflecting radiant energy includes a first and a second rear reflector which jointly form a stepped reflector. Both of the rear reflectors are of parabolic shape and have a focal point in the energy source or in the point where incoming radiant energy

is collected. The second rear reflector is disposed between the first rear reflector and the focal point.

There are further provided two front reflectors. The first front reflector is also of substantially parabolic shape having its focal point coincident with that of the stepped rear reflector. The first front reflector is so positioned and of such a shape as to intercept substantially all light which originates from the focal point and would otherwise pass through the opening of the first rear reflector. The second front reflector is of substantially spherical shape and forms a portion of the sphere having its origin in the focal point of the other reflectors. It is so disposed and dimensioned as to intercept substantially all energy rays originating from the focal points and directed through the opening of the first front reflector and above a predetermined plane such as a horizontal plane.

According to a second embodiment the top portion of the first rear reflector and the top portion of the first front reflector may have the shape of an anamorphoscope. According to a second embodiment both the first rear reflector and the first front reflector have the shape of an anamorphoscope. This will tend to compress either the top portion or both top and bottom portions of the resulting light beam and increase its intensity at the flat edges.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view in perspective of a sealed beam lamp suitable for use with an automobile and embodying the present invention;

FIG. **2** is a vertical sectional view of a light projector in accordance with the present invention;

FIG. **3** is a front elevational view of the projector of FIG. **1**;

FIG. **4** is a cross-sectional view of the light beam developed by the projector of FIGS. **2** and **3**;

FIG. **5** is a vertical sectional view of another embodiment of the present invention which will provide a light beam having a substantially flat top of high intensity;

FIG. **6** is a front elevational view of the apparatus of FIG. **5**;

FIG. **7** is a vertical sectional view of still another embodiment of the present invention which provides a light beam having a substantially horizontal top and bottom portion of increased intensity; and

FIG. **8** is a front elevational view of the apparatus of FIG. **7**

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and particularly to FIG. **1**, there is illustrated by way of example a sealed beam headlight lamp **10** for use with an automobile. As explained before, it will be understood that the apparatus of the invention may not only be used as a projector of light but may be generally used for all forms of radiant energy. Furthermore, it will be understood that it may not only be used for projecting radiant energy or reflecting it but also for collecting and receiving the same.

As shown in FIG. 1, the sealed beam lamp 10 is provided with a metallic envelope 11 and a front window 12 transparent to the light or in general to the radiant energy.

Referring now specifically to FIGS. 2 and 3, there is illustrated a first embodiment of the apparatus of the present invention. It includes a first rear reflector 14 and a second rear reflector 15 which jointly form a stepped rear reflector of parabolic form. Hence the two reflectors 14 and 15 have a common focal point in which the light source or energy source 16 may be located. The second rear reflector 15 is disposed between the first rear reflector 14 and the light source 16. Its opening is defined by a plane 17 which is spaced from the light source 16 and intersects the common axis of the two rear reflectors 14 and 15 and the light source 16 at right angles.

The light projector of FIGS. 2 and 3 is also provided with a front reflector 20 which may also be of parabolic shape and have its focal point in the light source 16. It is spaced from the light source 16 so that its rear opening is defined by a plane 21 parallel to and spaced from the plane 17. The front reflector 20 is so dimensioned and so disposed as to intercept substantially all of the light rays from the light source 16 which would otherwise pass through the opening of the rear reflector 14.

In case of an automobile sealed beam headlamp the opening of the rear reflector 14 may be closed by a window 12 of transparent material, that is transparent to the energy of the source 16.

It is still possible that light rays from the light source 16 may pass through the opening of the first front reflector 20 in an upward direction. This is prevented by the provision of the second front reflector 23.

The second front reflector 23 is of spherical shape and has its origin in the light source 16. Its lower portion is horizontally cut off as clearly shown at 24 in FIG. 3. Accordingly, it will obscure the light source 16 from an observer standing above a horizontal plane defined by the intersection of the lower edge 24 of the second front reflector 23 and the light source 16. The operation of the light projector of FIGS. 2 and 3 will now be explained.

A light ray such as shown at 25 is reflected by the first rear reflector 14 and emerges as a focused light beam. Similarly, a light ray such as shown at 26 which is directed toward the first front reflector 20 is reflected thereby and issues as a horizontal light ray to provide a second focused beam. This is due to the fact that any light beam originating from the focal point of a paraboloid will issue as a focused or parallel light beam.

As explained before, the front reflector 20 is so disposed and arranged to intercept light rays such as 26 which otherwise would issue through the opening of rear reflector 11. Additional light rays from the light source 16 which are intercepted by the second rear reflector 15 also issue as a central collimated light beam.

However, this would still make it possible for a light beam such as shown at 28 to pass through the opening of front reflector 20 in an upward direction. These light rays are reflected by the second front reflector 23 through the light source 16 onto the second rear reflector 15 to emerge as a light ray 30 in a parallel direction. Accordingly, the light source is obscured from any observer standing above a horizontal plane defined by the lower edge 24 of the second front reflector 23.

The various elements, that is the second rear reflector 15, the front reflector 20 and the second front reflector 23 may be secured to each other and either to the window 12 or to the first rear reflector 14 in any conventional manner. Preferably, the reflectors are secured by non-reflecting elements. For example, the various reflectors may be secured in the manner illustrated in FIG. 8 of the U.S. Pat. to Lessman No. 3,038,372 or as illustrated in FIG. 1 of the U.S. Pat. to Benjamin No. 1,880,399. Alternatively, the construction shown in FIG. 2 of the U.S. Pat. to Irujo No. 2,084,245 may be used. However, for the sake of clarity, these connections have not been shown in the drawings.

As shown particularly in FIG. 4, there will now be created a focused ring-shaped or annular outer light beam 32 corresponding to the ring-shaped area between the first rear reflector 14 and the first front reflector 20. A second concentric light beam 33, which is also ring shaped, is defined by the ring-shaped area between the front reflector 20 and the second rear reflector 15. Finally, the central light beam 34 of circular cross section corresponds to the light reflected by the second rear reflector 15. This light beam will be somewhat more intense than the light beam 33 because its intensity is increased by the light reflected by the second front reflector 23. The semi-circular area 35 corresponds to the shadow of the second front reflector 23. Besides the three focused light beams 32, 33 and 34, there will be a small amount of divergent light which passes from the light source 16 through the lower portion of the opening of the first front reflector 20. This additional light further illuminates the road.

Referring now to FIGS. 5 and 6, there is illustrated another embodiment of the present invention which serves the purpose to further compress the top of the light beam. To this end the upper portion 38 of the first rear reflector 14 is made in the shape of an anamorphoscope. A reflecting anamorphoscope is the equivalent of a cylinder lens and has the property of compressing the light in a predetermined plane. Thus, the first rear reflector 14 is asymmetrical in shape and has a lower portion in the shape of a paraboloid and the upper portion 38 in the shape of an anamorphoscope. The envelope or housing 11 may retain its conventional parabolic shape so that the projector of the invention may be readily installed in a conventional envelope or housing.

The upper portion 40 of the second rear reflector 15 also has the same shape, that is the shape of an anamorphoscope. The same applies to the upper portion 41 of the first front reflector 20. As clearly shown in FIG. 6, the three reflectors 38, 40 and 41 each have a flat-topped upper portion. It will therefore be realized that the corresponding light beams such as 32, 33 and 34 as shown in FIG. 4 will also each have a flat top portion. Due to the fact that the light has been compressed, these top portions are more intense than the remainder of the beams.

As a result the light beam will reach farther ahead of a car so equipped.

Referring now to FIGS. 7 and 8, there is illustrated still another embodiment of the present invention. The light projector of FIGS. 7 and 8 generates a light beam which has essentially flat top and bottom portions which are more intense than the remainder of the light beam. This is accomplished by forming the first rear reflector **14** with both a top portion **38** and a bottom portion **42** in the shape of an anamorphoscope. In other words the entire first rear reflector **14** has the shape of an anamorphoscope. The same is true of the second rear reflector **15** where both the top portion **40** and the bottom portion **43** have the shape of an anamorphoscope. Finally, the first front reflector **20** also has not only a top portion **41**, but a bottom portion **44** of the shape of an anamorphoscope. Thus to summarize, both rear reflectors **14** and **15** and the front reflector **20** have the shape of an anamorphoscope with a common focal point in the light source **16.** As a result, it will be realized that the three light beams such as shown at **32** to **34** in FIG. **4** will all have substantially flat top and bottom portions of increased intensity.

It may be pointed out that the transparent window **12** may be omitted except in the case of the sealed beam lamp of a car. Also, the light source **16** need not necessarily be a point-like light source as shown schematically in the drawings, but may be of extended form. It may, for example, consist of a single filament or of a double filament such as are used in some automobile sealed beam lamps to provide both the high and low beam in a single lamp structure.

The various reflectors of the light projector of the invention may be manufactured in any suitable manner. For example, they may be molded, forged, stamped, welded machined or electroformed. Suitably, the reflectors may be formed on a mold from a suitable plastic material which may subsequently be coated with a light reflecting material such, for example, as aluminum. It will be understood that other materials such as safety glass, metal, plastic, or ceramic may be used for the apparatus of the invention.

There has thus been disclosed apparatus for collecting or reflecting radiant energy. Specifically, the apparatus may be used as a light projector. It may be so designed that no light can escape in an upward direction above a predetermined plane to minimize glare. This of course will obscure the light source from an observer above a predetermined plane. Nevertheless, substantially no light is lost but all light is simply redirected into a desired direction. The resulting light beam may be caused to have three concentric portions which may be made to have either a flat top or a flat bottom or both flat top and bottom portions. These flat portions are of increased light intensity due to the fact that they are created by a reflector in the shape of an anamosphoscope which tends to compress the light. This helps to direct the light beam further ahead with the same amount of candle power which is presently limited in the case of cars. Since the light projector used only reflecting elements, there is no chromatic aberration. It will be realized that the greater portion of the energy is reflected only once in a solid angle from the source into the desired beam. Only the small portion of the light collected by the second front reflector is reflected twice.

What is claimed is:

1. A radiant energy collecting or reflecting system for collecting or reflecting radiant energy from or into a predetermined area, said system comprising:

a. a first rear reflector of substantially parabolic shape, said first rear reflector having a focal point toward which to direct incoming radiant energy or from which to direct radiant energy outwardly;

b. a second rear reflector of substantially parabolic shape disposed between said focal point and said first rear reflector, said second rear reflector having a focal point substantially coinciding with that of said first rear reflector whereby said rear reflectors jointly form a stepped reflector;

c. a first front reflector of substantially parabolic shape having its focal point substantially coinciding with that of said rear reflectors, said first front reflector being apertured to pass light therethrough and being disposed for intercepting substantially all energy rays which would originate from said focal point and pass through the opening of said first rear reflector; and

d. a second front reflector of substantially spherical shape forming a portion of a sphere having its origin substantially coinciding with said focal points, said second front reflector being so disposed as to intercept all rays originating from said focal points and directed through the opening of said first front reflector and above a predetermined plane.

2. A reflecting system as defined in claim **1** wherein corresponding portions of said first and second rear reflectors are substantially anamorphic reflectors, and wherein the corresponding portion of said first front reflector is a substantially anamorphic reflector.

3. A reflecting system as defined in claim **1** wherein said first and second rear reflectors and said first front reflector are substantially anamorphic reflectors.

4. A radiant energy reflecting system for directing radiant energy in predetermined directions, said system comprising:

a. a radiant energy source;

b. a first rear reflector of substantially parabolic shape having its focal point substantially in said energy source;

c. a second rear reflector of substantially parabolic shape providing with said first rear reflector a stepped reflector and having its focal point substantially in said energy source, said second rear reflector being disposed between said first reflector and said energy source;

d. a first front reflector of substantially parabolic shape disposed ahead of said energy source and having a focal point substantially in said energy source, said first front reflector being disposed to intercept substantially all rays which would otherwise pass through the opening of said first rear reflector, said first and second rear reflectors and said first front reflector having openings disposed in substantially parallel planes; and

e. a second front reflector of substantially spherical shape having its origin substantially in said energy source, said second front reflector being disposed within said first front reflector so as to intercept substantially all energy rays which would otherwise pass above a predetermined horizontal plane, whereby said reflecting system will project three concentric light beams of substantially circular shape with substantially no energy being directed above said predetermined horizontal plane.

5. A reflecting system as defined in claim **4** wherein the opening of said first rear reflector and of said first front reflector is closed by a window of a material transparent to the radiant energy.

6. A radiant energy reflecting system for directing radiant energy in predetermined directions, said system comprising:

a. a radiant energy source;

b. a first rear reflector having an upper substantially anamorphic reflector portion and a lower portion of substantially parabolic shape having its focal point substantially in said energy source;

c. a second rear reflector having an upper substantially anamorphic reflector portion and a lower portion of substantially parabolic shape providing with said first rear reflector a stepped reflector and having its focal point substantially in said energy source, said second rear reflector being disposed between said first reflector and said energy source;

d. a first front reflector having an upper substantially anamorphic reflector portion and a lower portion of substantially parabolic shape disposed ahead of said energy source and having a focal point substantially in said energy source, said first front reflector being disposed to intercept substantially all rays which would otherwise pass through the opening of said first rear reflector, said first and second rear reflectors and said first front reflector having openings disposed in substantially parallel planes; and

e. a second front reflector of substantially spherical shape having its origin substantially in said energy source, said second front reflector being disposed within said first front reflector so as to intercept substantially all energy rays which would otherwise pass above a predetermined horizontal plane, whereby said reflecting system will project three concentric light beams with substantially no energy being directed above said predetermined horizontal plane.

7. A reflecting system as defined in claim 6 wherein the opening of said first rear reflector and of said first front reflector is closed by a window of a material transparent to the radiant energy.

8. A radiant energy reflecting system for directing radiant energy in predetermined directions, said system comprising:

a. a radiant energy source;

b. a first substantially anamorphic rear reflector having its focal point substantially in said energy source;

c. a second substantially anamorphic rear reflector providing with said first rear reflector a stepped reflector and having its focal point substantially in said energy source, said second rear reflector being disposed between said first reflector and said energy source;

d. a first substantially anamorphic front reflector disposed ahead of said energy source and having a focal point substantially in said energy source, said first front reflector being disposed to intercept substantially all rays which would otherwise pass through the opening of said first rear reflector, said first and second rear reflectors and said first front reflector having opening disposed in substantially parallel planes; and

e. a second front reflector of substantially spherical shape having its origin substantially in said energy source, said second front reflector being disposed within said first front reflector so as to intercept substantially all energy rays which would otherwise pass above a predetermined horizontal plane, whereby said reflector system will project three concentric light beams with substantially no energy being directed above said predetermined horizontal plane.

9. A reflecting system as defined in claim 8 wherein the opening of said first rear reflector and of said first front reflector is closed by a window of a material transparent to the radiant energy.

* * * * *