United States Patent

[11] 3,634,675

[72] Inventors **Andrew Madsen**
Alamo;
John W. Hardy, Danville, both of Calif.

[21] Appl. No. **848,205**
[22] Filed **Aug. 7, 1969**
[45] Patented **Jan. 11, 1972**
[73] Assignee **Unitron International Systems, Inc.**

[54] **HIGH-INTENSITY RADIATION DEVICE**
7 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **240/1.2,** 240/41.37, 340/25, 340/117
[51] **Int. Cl.** **B64f 1/20**
[50] **Field of Search** 240/1.2, 41.1, 8.22, 41.37, 22, 10.66, 10.63; 340/84, 25, 114, 116, 117; 181/31.1

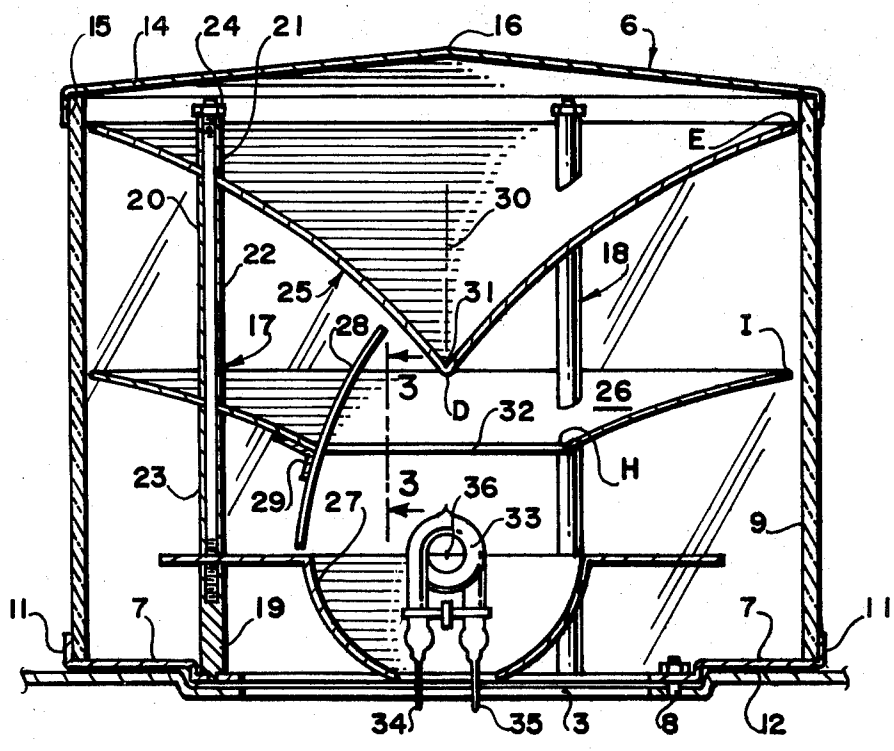
[56] **References Cited**

UNITED STATES PATENTS

1,469,690	10/1923	Smith	240/41.37 X
1,793,663	2/1931	Wood	240/41.37
3,264,463	8/1966	Bonner, Jr.	240/10.66
3,403,249	9/1968	Bennett	240/22 X
3,443,086	5/1969	Rickis	240/41.1
1,686,656	10/1928	Geddes	240/41.1
1,814,669	7/1931	Cushing	240/44.1 X
2,191,379	2/1940	Glasgow	240/1.2
3,504,339	3/1970	Bailey	340/84

Primary Examiner—Louis J. Capozi
Attorney—Walter M. Rodgers

ABSTRACT: A compact high-intensity radiation device suitable for use as a light signaling means and for other purposes includes a base, an enclosing envelope mounted on the base and constructed of translucent material together with a cover portion of opaque material mounted atop the envelope to define a housing structure in which a main reflector and a secondary reflector are disposed in coaxial relationship with each other, each of said reflectors having reflecting surfaces of parabolic configuration. A point source of light is mounted at the focus of both the main and secondary reflectors and is surrounded by a hemispherical reflector. All reflectors are supported on the base by means of a plurality of support studs and a cutoff reflector is mounted on the secondary reflector to prevent undesired reflections within a limited segment, the device being generally adapted to direct a cone of light in all remaining horizontal directions and wherein the cone of light may be directed through an angle between a minimum of approximately 2° above horizontal and a maximum of approximately 20° thereabove.



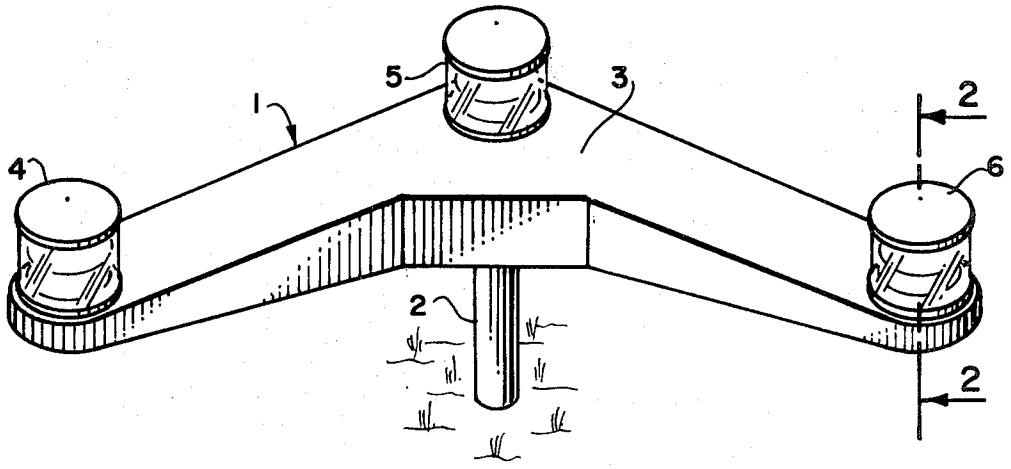


FIG. 1

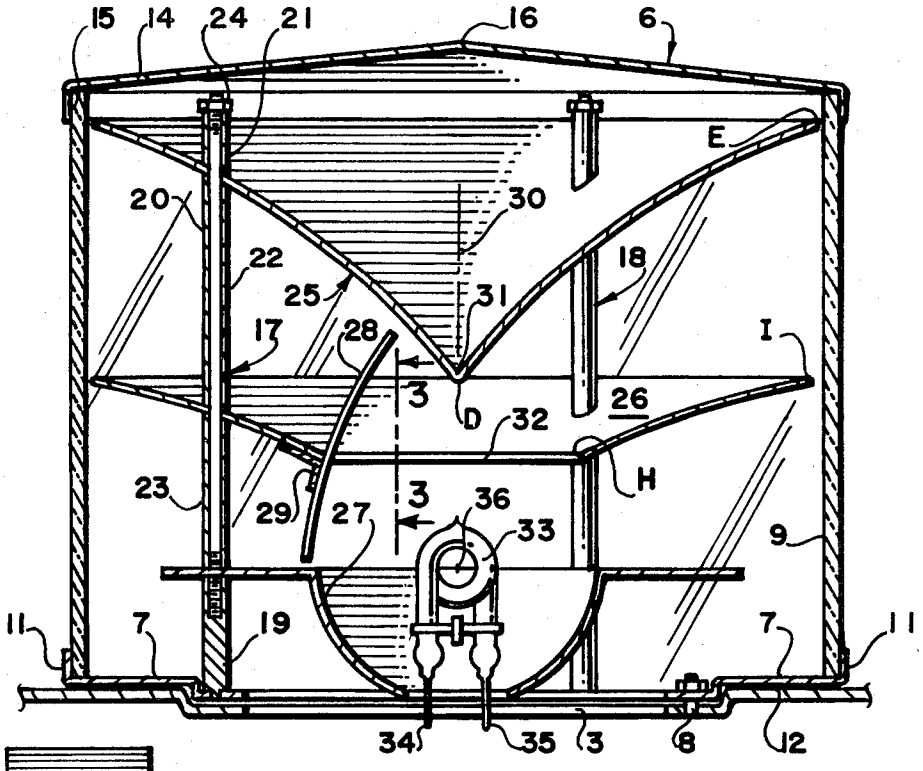


FIG. 2

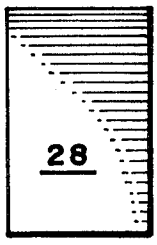


FIG. 3

INVENTORS
ANDREW MADSEN
JOHN W. HARDY
BY Walter M. Rodgers
ATTORNEY

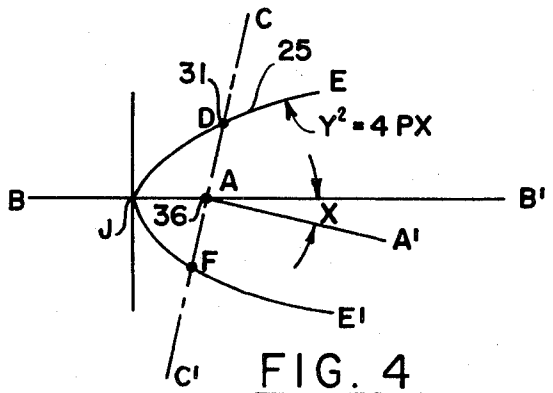


FIG. 4

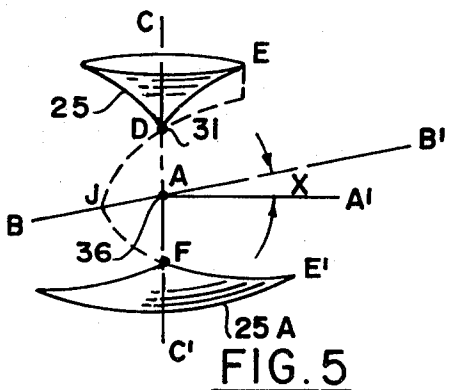


FIG. 5

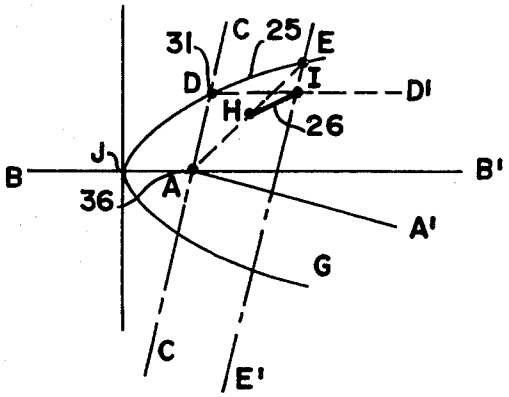


FIG. 6

INVENTORS
ANDREW MADSEN
JOHN W. HARDY
BY Walter M. Rodgers
ATTORNEY

HIGH-INTENSITY RADIATION DEVICE

Airport-lighting systems and particularly runway markers and the like are difficult to locate by the pilot of an incoming aircraft due to the great profusion of lights of varying sizes, colors and dispositions found in the vicinity of most airports. This condition is particularly vexing and conducive to pilot frustration because the region immediately surrounding an airport is also a region of high-traffic density.

In order to overcome the aforementioned difficulty and in accordance with this invention, a high-intensity source of visible radiation is provided by incorporating a plurality of reflectors constructed with reflecting surfaces arranged coaxially with respect to each other and constructed so that a cross section of each such reflector coincides with a portion of a parabola, the foci of which all coincide with a high-intensity light source. Preferably the light source is mounted at the focal point of a hemispheric reflector whose open side is disposed adjacent the parabolic reflectors. A cutoff reflector may be mounted on one of the parabolic reflectors and all of the reflectors are mounted on a base element by means of supporting studs and the entire reflector structure is housed within an envelope mounted on the base and constructed of translucent material atop which a cover of opaque material is affixed.

A radiation device constructed according to this invention can be constructed in a compact fashion due in part to the fact that reflection of radiation from a point source of radiation is precisely controlled to obtain high efficiency.

While the invention as disclosed and described herein is primarily intended for the production of visible light, it will be understood that invisible portions of the spectrum may be employed in conjunction with the invention if desired.

For a better understanding of the invention reference may be had to the following detailed description taken in conjunction with the accompanying drawings in which

FIG. 1 is a generalized schematic view of an airport indicating device on which a plurality of radiation devices constructed according to this invention are mounted;

FIG. 2 is an enlarged cross-sectional view of one of the radiation devices shown in FIG. 1 and constructed according to this invention, the view being taken along the line designated 2—2 in FIG. 1;

FIG. 3 is a fragmentary cross-sectional view of a portion of FIG. 2 and taken along the line designated 3—3 in FIG. 2 and in which;

FIGS. 4, 5 and 6 are diagrammatic representations of geometric figures which illustrate some of the principles employed in the construction of a radiation device such as is shown in FIGS. 1, 2 and 3.

In FIG. 1, an airport luminaire is generally designated by the numeral 1 and comprises a vertically disposed pedestal 2 atop which an arrow shaped luminaire housing 3 is affixed. Mounted atop the luminaire housing 3 are three radiation devices designated by the numerals 4, 5 and 6. Ordinarily the radiation devices 4, 5 and 6 constitute sources of visible radiation and may be energized from an external source of electric current by means of suitable circuitry disposed within the housing 3 and connected with the radiation devices 4, 5 and 6.

In FIG. 2 one radiation device such as 6 is shown in cross section and comprises a baseplate 7 affixed to the luminaire housing 3 by a plurality of bolts 8. A circular envelope 9 of translucent material is affixed to the flange 11 of a base 7 which is mounted atop a cushion 12 of suitable rubber, plastic or other means of weatherproofing or the like. Disposed atop translucent envelope 9 is an opaque cover 14 secured to envelope 9 by cement 15 or by any other suitable means. Since the cover 14 ordinarily is required to shield the device from precipitation, it is normally constructed with a high-center point 16.

For the purpose of supporting the internal reflecting and other structure of the radiation device, a plurality of support studs generally designated by the numerals 17 and 18 are affixed to baseplate 7. These studs are identical in construction. With reference to stud 17 an internally threaded pedestal 19 is affixed to baseplate 7 and an externally threaded rod 20 is screwed thereinto. A plurality of sleeves 21, 22 and 23 are disposed about rod 20 and a nut 24 is threadedly secured atop rod 21. The studs 17 and 18, as is apparent in FIG. 2, support the main reflector generally designated by the numeral 25, the secondary reflector generally designated by the numeral 26 and the hemispherical reflector generally designated by the numeral 27. The cutoff reflector generally designated by the numeral 28 is affixed by bracket 29 to secondary reflector 26. Of course bracket 29 may be welded or otherwise secured to reflectors 26 and 28.

As is apparent from FIG. 2, the main reflector 25, the secondary reflector 26 and the hemisphere 27 are coaxially disposed along the main axis 30 of the radiation device. A center point 31 of main reflector 25 is mounted in coincidental relationship with the main axis 30 of the device and a central cutaway opening 32 is formed within the secondary reflector 26 and is circular in configuration. The center of the cutaway portion 32 is disposed in coincidence with the main axis 30 of the device.

As is apparent from FIG. 2, the point source of radiation 33 may constitute a source of light such as a stroboscope lamp energized from an external source and through suitable circuitry by means of electric conductors 34 and 35. The center point 36 of point source of radiation 33 is disposed at the focal point of hemispherical reflector 27.

The invention is based on principles which ideally contemplate a point source of radiation. In practice the source of radiation has a finite volume and is disposed so that its centroid coincides with the focal point of the parabola as represented by numeral 36 in FIG. 2.

From the above description, it is apparent that radiation emanating from point source of radiation 33 is directed upwardly by the hemispherical reflector 27. The reflecting surfaces of reflectors 25 and 26 are constructed so that cross sections thereof in a direction radially thereof are of parabolic configuration and the focus of the parabola for both the main reflector 25 and the secondary reflector 26 are located at and coincide with the point source of radiation 33.

A derivation of the above description may best be understood with reference to FIGS. 4, 5 and 6.

In FIG. 4 a parabola E, D, J, F and E′ is shown with its axis designated at B, B′ and with its focus designated at A and its vertex at J. As is well known, an automobile head lamp, for example, constructed with its cross section configured according to the parabola E, D, J, F, and E′ and with a point source of light located at its focus A is effective to direct a beam of light toward the right along the axis B, B′ and such light beams converge at infinity.

Since a reflector for use as a signaling device around airports and the like must be capable of providing a signal which is observable from the vantage point of aircraft approaching from all directions, it is necessary to provide a device which emanates radiation in an efficient manner and which can be seen by all approaching craft from great distances.

In order to provide a reflector having the desired characteristics, a construction line such as is indicated at C, C′ in FIG. 4 may be applied to the parabola of that figure and the entire figure canted about the focus A in a counterclockwise direction through the angle X. When so tilted the axis C, C′ appears as indicated in FIG. 5. The parabola E, D, J, F, E′ then appears as shown in FIG. 5 and the focus A is disposed in coaxial vertical alignment with the points D and F and the vertex is at J. Thus from FIG. 5, it is apparent that the arcuate line D, E in effect is a part of the parabola E, D, J, F, E′. Furthermore as is apparent from FIG. 5, the main reflector such as 25 of FIG. 2 may be provided in which the center point 31 coincides with the point D of FIG. 4. Of course the generally conical conical main reflector 25 is constructed so that an imaginary radial line drawn from the center point 31 (D) through the reflector unit outwardly defines a cross section which is in coincidence with a part such as DE of an imaginary parabola.

A reflector constructed according to FIG. 5 utilizes a lower reflector 25A the portion F, E' of which is defined by a portion of parabola E, D, J, F, E'.

While a main reflector constructed as indicated in FIG. 5 is satisfactory for many purposes, it has been determined that for most airport signaling purposes it is preferable to replace the lower reflector such as 25A with a hemispherical reflector such as is indicated at 27 in FIG. 2. By this means all of the light or other radiation emanating from the point source reflector 33 is directed upwardly. Furthermore, the center of and focal point of the hemispherical reflector 27 preferably is arranged to coincide with the focus A of the parabola E, D, J, F, E', i.e., of conical main reflector 25.

Thus by means of the main reflector 25 and the hemispherical reflector 27 constructed according to FIGS. 2 and 5, a device is provided according to one aspect of the invention which effectively directs radiation upwardly through a limited vertical angle outwardly and somewhat above the horizon and through 360°. For some purposes a reflector utilizing the main reflector 25 and hemispheric reflector 27 having common focal points at A as indicated in FIG. 5 is useful.

The light which is reflected from the main reflector 25 is controlled and is a part of an efficient high-intensity radiation of light along axis B, B' which inscribes a shallow cone. The light however which emanates directly from point source of radiation 33 and which proceeds upwardly and outwardly without reflecting from the main reflector is largely unconcentrated and to some extent wasted because it is not controlled and directed in an efficient manner.

According to one aspect of the invention, the supplementary reflector 26 is added so as to prevent the passage of a great deal of radiation directly from point source 33 outwardly without being diverged and controlled by a reflector.

As already pointed out secondary reflector 26 is provided with a central circular aperture 32 which constitutes a cutaway portion about which the reflecting portion is generally symmetrically disposed. The secondary reflector 26 is also constructed so that a cross section taken along a radial line emanating from the main axis 30 of the device and through center point 31 of reflector 25 and drawn through the reflecting surface of secondary reflector 26 is arranged so as to coincide with a parabola. For example, and with reference to FIG. 6 the line E, E' is drawn parallel to the line C, C' and the line D, D' is drawn parallel with the line B, B' so that line D, D' and E, E' intersect at a point designated I.

From FIG. 6 it is obvious that radiation from the point source 33 which is disposed at focus A in FIG. 6 and which reflects from the main reflector 25 along the line designated in FIG. 6 by D, E will not strike the secondary reflector 26 as designated by H, I due to the fact that center point 31 of reflector 26 as designated by the letter D is at approximately the same level or distance from the axis B, B' of parabola E, D, J, E'. By the same token radiation emanating from source 33 at focus A may engage the right-hand surface of reflector 26 and be directed toward the right as is apparent from FIG. 6 in a direction along the axis B, B' because the parabola defining segment H, I is canted so that its focal point coincides with the focal point A. Thus uncontrolled radiation from point A upwardly and outwardly in all directions is not lost but instead is controlled by the main reflector 25 and by the secondary reflector 26.

Should the radiation from point source 33 at focus A outwardly and below the effective area of reflector 26 be wasted to such an extent as to be intolerable, a tertiary reflector constructed similar to secondary reflector 26 and in keeping with the construction principles set forth in FIG. 6 may be provided if desired. Of course the invention is not limited simply to a main, a secondary and a tertiary reflector and any number of reflectors may be coaxially disposed along the main axis 30 and arranged so that their reflecting surfaces are constructed so that in cross section they are of a parabolic configuration and with the foci thereof disposed in coincidence with the main source of radiation 33.

According to this invention a high-intensity reflector is provided which may be seen for many miles by the pilot of an aircraft approaching an airport and furthermore controlled radiation may be provided in a very compact structure of only a few inches in height and in diameter.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A radiation device comprising a continuous 360°-parabolic main reflector having an axis of symmetry in coincidence with the main axis of the device and having a reflecting surface configured so that a cross section of said reflecting surface in any plane in which the main axis of the device lies is part of a parabola with the geometric focal point of said parabola located on the main axis of the device and with the geometric axis of said parabola intersecting the main axis of the device and being angularly disposed with respect to the main axis, a point source of radiation disposed at said focal point, and a secondary reflector comprising a continuous 360°-parabolic reflector having a reflecting surface configured so that a cross section of said reflecting surface in any plane in which the main axis of the device lies is part of a parabola with the geometrical focal point and geometrical axis coincident with the geometrical focal point and axis of said main reflector, said secondary reflector being interposed between said main reflector and said point source of radiation and said secondary reflector having a cutaway center portion.

2. A device according to claim 1 wherein the outer periphery of said secondary reflector is disposed to accommodate reflections from said main reflector in the direction of the axis of its imaginary parabola without interference therewith.

3. A device according to claim 1 wherein the outer periphery of said secondary reflector is spaced from the axis of the imaginary parabola of said main reflector by a distance substantially equal to the spacing between said center point of said main reflector and said axis.

4. A device according to claim 1 wherein the outer peripheries of said main and of said secondary reflectors are substantially coincidental along lines which are parallel to the main axis of the device.

5. A device according to claim 1 wherein a cutoff reflector is secured to said secondary reflector along the inner edge of said reflecting portion and extending through the cutaway portion thereof.

6. A device according to claim 5 wherein said cutoff reflector is of generally arcuate configuration in a plane parallel to the main axis of the device.

7. A radiation device comprising a continuous 360°-parabolic main reflector having an axis of symmetry in coincidence with the main axis of the device and having a reflecting surface configured so that a cross section of said reflecting surface in any plane in which the main axis of the device lies is part of a parabola with the geometric focal point of said parabola located on the main axis of the device and the geometric axis of said parabola intersecting the main axis of the device and being angularly disposed with respect to the main axis, and a point source of radiation disposed at said focal point.

* * * * *