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PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO REFLECTING DEVICES FOR CONCENTRATING A WAVEFLUX

(71) We, COMPAGNIE DES LAMPES, a French Body Corporate, of 29, rue de Lisbonne, 75008 Paris, France, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to reflecting devices for concentrating wavefluxes.

According to the invention, there is provided a reflecting device for concentrating a waveflux, comprising a first trough-shaped reflector having a section of parabolic shape transverse to a desired direction of propagation of a wavebeam reflected therefrom, the focus of the parabolic section being coincident with a flux emitting area of a source for producing said flux, a second reflector disposed within the first reflector ahead of the source for controlling the direction of reflection of a portion of the waveflux which is defined by a solid angle formed by two generatrices extending from said flux emitting area to the outer edges of the first reflector, a cross section of the second reflector, which contains a main axis of propagation of the emergent beam, consisting of at least two parabolic portions having a common focus located in said emitting area, each parabolic portion of said cross section of the second reflector being defined by a corresponding portion of a branch of a parabola which has its axis coincident with the main axis of the emergent beam and its focus located in said emitting area and which has been rotated about said focus through a respective angle such that the second reflector remains within the waveflux portion defined in said solid angle, the two parabolic portions of the second reflector differing from each other by at least one of the following three characteristic features: the distance from their outermost edges to the main axis; the values of the angles defining their respective rotations about the focus; the value of the parameter defining the parabola from which each parabolic portion is derived.

Such a device may be used to permit a secondary emission of flux, notably of light flux, in a privileged direction which differs from that of the main emissive axis.

For instance, such a reflecting device may be mounted on a tower for illuminating, inter alia, a football pitch and at the same time the base of the tower.

The invention will be further described, by way of example, with reference to the accompanying drawing, in which:

Figure 1 is a cross-sectional view of a preferred reflecting device the section being taken along any desired transverse vertical plane intermediate the ends of the reflector; and

Figure 2 is a modified detail of the structure illustrated in Figure 1.

The reflecting device comprises a first trough-shaped reflector of which a cross-section 1 contains the main axis 2 of propagation of the emergent waveflux 3. This cross-section 1 of the first reflector comprises a parabolic portion 4. The flux emitting area 5 of source 6 is preferably coincident with the focus 5 of the parabolic portion 4 of the first reflector 1. The device further comprises, ahead or downstream of said source 6, a second reflector 7 disposed within the first reflector 1 for controlling the aperture of one portion 8 of the waveflux defined by a solid angle formed between a pair of generatrices 9 and 10 extending from the flux emitting area 5 to the outer edges 11, 12 of the first reflector 1. In a flat section containing the axis 2 of propagation of the emergent beam 3 the second reflector 7 is shown as consisting of pair of registering parabolic portions 13, 14 having a common focus located in close vicinity of the flux emitting area 5. As shown in Figure 2, the position of each parabolic portion 13, 14 of the plane section of second reflector 7 is deducted from the position of one portion 15 of a branch 16 of a parabola of which the axis is coincident with that of the main emergent beam 3 and the focus lies in said flux emitting area 5, by rotating said portion 15 of parabolic branch 16 about said focus 5 through a certain angle α the value of which is subordinate to the desired aperture β of waveflux portion 8.

An obvious relationship exists between the aperture angle of waveflux portion 8 and the angle of rotation of a single parabolic portion 13 or 14 of the second reflector 7 such that the aperture angle decreases (from an initial aperture angle defined by the constructional characteristics of the parabolic portions of second reflector 7) as the angle of rotation of the parabolic portion 13 or 14 concerned increases.

However, whereas the known reflecting device was obtained by rotating each one of said two parabolic portions, of equal length, through a same angle α (so that the obvious relationship between the aperture angle of waveflux portion 8 and the angle of rotation of the two parabolic portions may be expressed mathematically by the fact that the sum $\beta+2\alpha$ is constant and more particularly equal to the aperture angle of the second reflector before rotating the two parabolic portions), and whereas the parabolic portions 13 and 14 of the known device derive from a same parabola, i.e. have the same mathematical parameter, it is the essential feature of the present invention that the two parabolic portions 13 and 14 of the second reflector 7 differ from each other by at least one of the following three features: the distance from their foremost edge to the main axis 2, the value of the angle defining their rotation about the focus 5, and the value of the parameter defining the parabola from which each portion 13 or 14 is derived.

Preferably, the parabolic portions 13 and 14 differ at least by the value of the angle defining their rotation about the focus and possibly, in addition, by the parameter defining the parabola from which each portion 13 or 14 is derived.

Let us define a plane reference orthostandardized by the main axis 2 constituting the X-axis (abscissae) and by the Y-axis, which is the ordinate axis.

If we introduce two indices *i* and *f* for characterizing any magnitude defined before and after the rotation of the portions of parabola (*i*=initial, *f*=final), respectively,

—if we define as follows:

α_1 the angle of rotation of parabolic portion 13,

α_2 the angle of rotation of parabolic portion 14,

p_1 the parameter of the parabola from which portion 13 is derived,

p_2 the parameter of the parabola from which portion 14 is derived,

η_1 and η_2 the (positive) values of the distances measured from the outermost edges 13*a* and 14*a* of parabolic portions 13 and 14, respectively to the main axis, η_{1i}, η_{2i} and η_{if}, η_{2f} the values of the same distances before and after the rotation of the parabolic portions, respectively, then the structure of the device according to the invention is such that the following three requirements are met:

If $\alpha_1=\alpha_2$ and $P_1=P_2$, then $\eta_{if}\neq\eta_{2f}$

If $\alpha_1=\alpha_2$ and $\eta_{if}=\eta_{2f}$, then $P_1\neq P_2$, and

If $P_1=P_2$ and $\eta_{if}=\eta_{2f}$, then $\alpha_1\neq\alpha_2$.

Moreover, if β_1 and β_2 designate the aperture portions of flux sector 8 which on either side of the main axis 2 are adjacent the parabolic portions 13 and 14, respectively, so that $\beta_1+\beta_{2f}=\beta$, the elementary trigometry and the general equation of the parabolas in the above-defined plane reference will give the following relationships:

$$\mathrm{tg}\beta_{1i}=\frac{2P_1\cdot\eta_{1i}}{\eta_{1i}^2-P_1^2}$$

and

$$\mathrm{tg}\beta_{2i}=\frac{2P_2\cdot\eta_{2i}}{\eta_{2i}^2-P_2^2}$$

or

$$\alpha_1=\beta_{1i}-\beta_{1f}$$

and

$$\alpha_2=\beta_{2i}-\beta_{2f}$$

so that

$$\alpha_1 = \text{Arctg}\frac{2P_1 \cdot \eta_{1i}}{\eta_{1i}^2 - P_1^2} - \beta_{1f}$$

and

$$\alpha_2 = \text{Arctg}\frac{2P_2 \cdot \eta_{2i}}{\eta_{2i}^2 - P_2^2} - \beta_{2f}$$

and finally

$$\boxed{\alpha_1 + \alpha_2 = \text{Arctg}\frac{2P_1 \cdot \eta_{1i}}{\eta_{1i}^2 - P_1^2} + \text{Arctg}\frac{2P_2 \cdot \eta_{2i}}{\eta_{2i}^2 - P_2^2} - \beta}$$

This expression is the developed mathematical form of the relationship existing between the angles of rotation α_1 and α_2 of the parabolic portions 13 and 14, on the one hand, and the desired aperture angle β, on the other hand, through the medium of terms which are only subordinate to the shape and length of the parabolic branches selected for constructing the second reflector 7.

The cross section of the first reflector 1 may comprise, in the vicinity of its vertex 17, two hyperbolic portions 18, 19 disposed symetrically in relation to said vertex 17. The cross section of each hyperbolic portion 18 or 19 has a first focus at the waveflux emitting area 5; the locations of the second foci 20 and 21, respectively, of each hyperbolic portion 18, 19 are so selected that the beams 22 and 23 reflected by each hyperbolic portion 18, 19 respectively pass between the second reflector 7 and the outer edges 11 and 12, respectively, of the first reflector 1. The vertex 17 of the vertical cross section of the first reflector 1 may have an orifice formed therethrough but, as shown in Figures 1 and 3, it will comprise preferably a substantially V-shaped portion 24 having its sides so disposed that the waves impinging thereagainst from the emitting area 5 are reflected into said emergent beam 3 by only one complementary reflection 25 on the surface of said first reflector 1.

It is clear that the surfaces referred to hereinabove as "parabolic" or "hyperbolic" ones may consist of adjacent, substantially flat facets tangent to the mathematical envelope of a parabola or an hyperbola.

WHAT WE CLAIM IS:—

1. A reflecting device for concentrating a waveflux, comprising a first trough-shaped reflector having a section of parabolic shape transverse to a desired direction of propagation of a wavebeam reflected therefrom the focus of the parabolic section being coincident with a flux emitting area of a source for producing said flux, a second reflector disposed within the first reflector ahead of the source for controlling the direction of reflection of a portion of the waveflux which is defined by a solid angle formed by two generatrices extending from said flux emitting area to the outer edges of the first reflector, a cross section of the second reflector, which contains a main axis of propagation of the emergent beam, consisting of at least two parabolic portions having a common focus located in said emitting area, each parabolic portion of said cross section of the second reflector being defined by a corresponding portion of a branch of a parabola which has its axis coincident with the main axis of the emergent beam and its focus located in said emitting area and which has been rotated about said focus through a respective angle such that the second reflector remains within the waveflux portion defined in said solid angle, the two parabolic portions of the second reflector differing from each other by at least one of the following three characteristic features: the distance from their outermost edges to the main axis; the values of the angles defining their respective rotations about the focus; the value of the parameter defining the parabola from which each parabolic portion is derived.

2. A device as claimed in claim 1, in which the two parabolic portions differ from each other by the value of the angle defining their rotation about the focus.

3. A device as claimed in claim 2, in which the two parabolic sections further differ from each other by the value of the parameter defining the parabola from which each parabolic portion is derived.

4. A reflecting device substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*