Nov. 2, 1965 M. H. H. ADAM 3,215,980

REFLECTING DEVICE FOR PUBLIC STREET LIGHTING APPLIANCES
AND LIGHTING APPLIANCES FITTED WITH THIS DEVICE

Filed Jan. 14, 1963 3 Sheets-Sheet 1

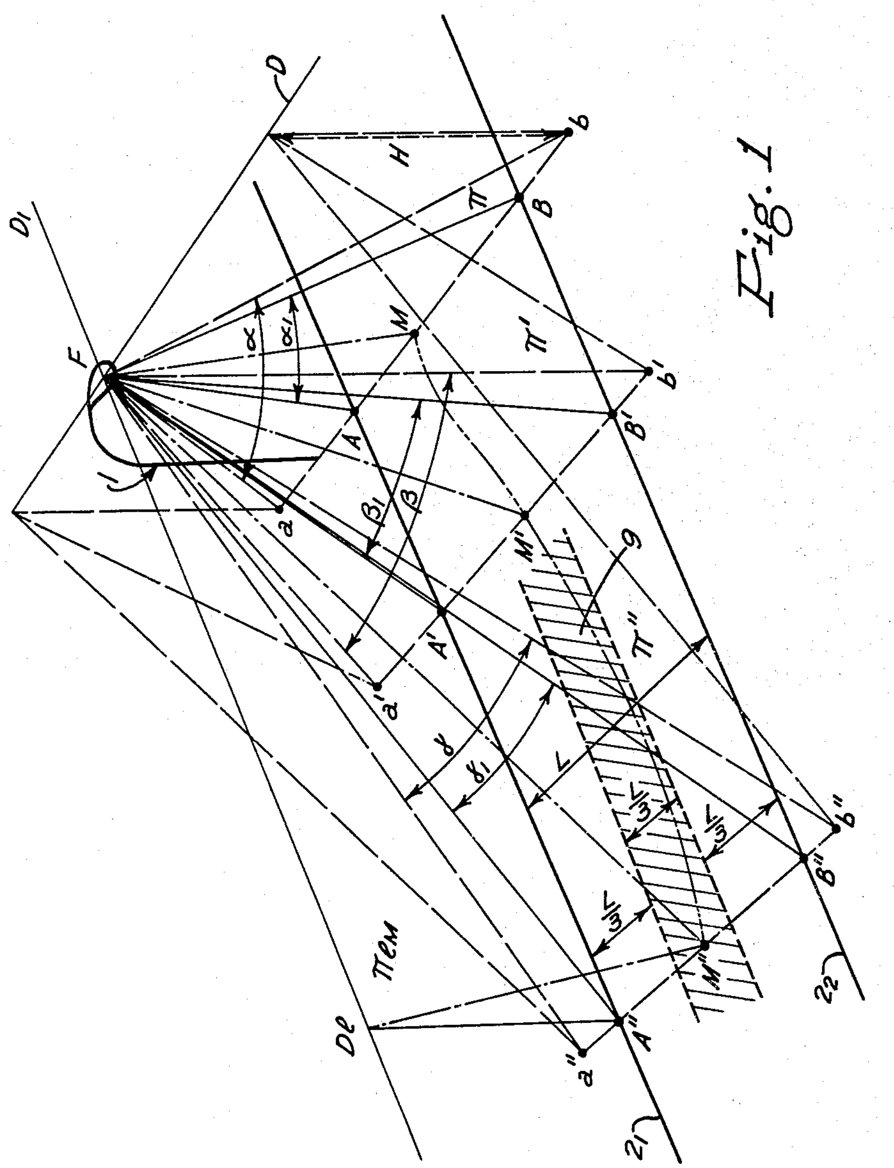

Fig. 1

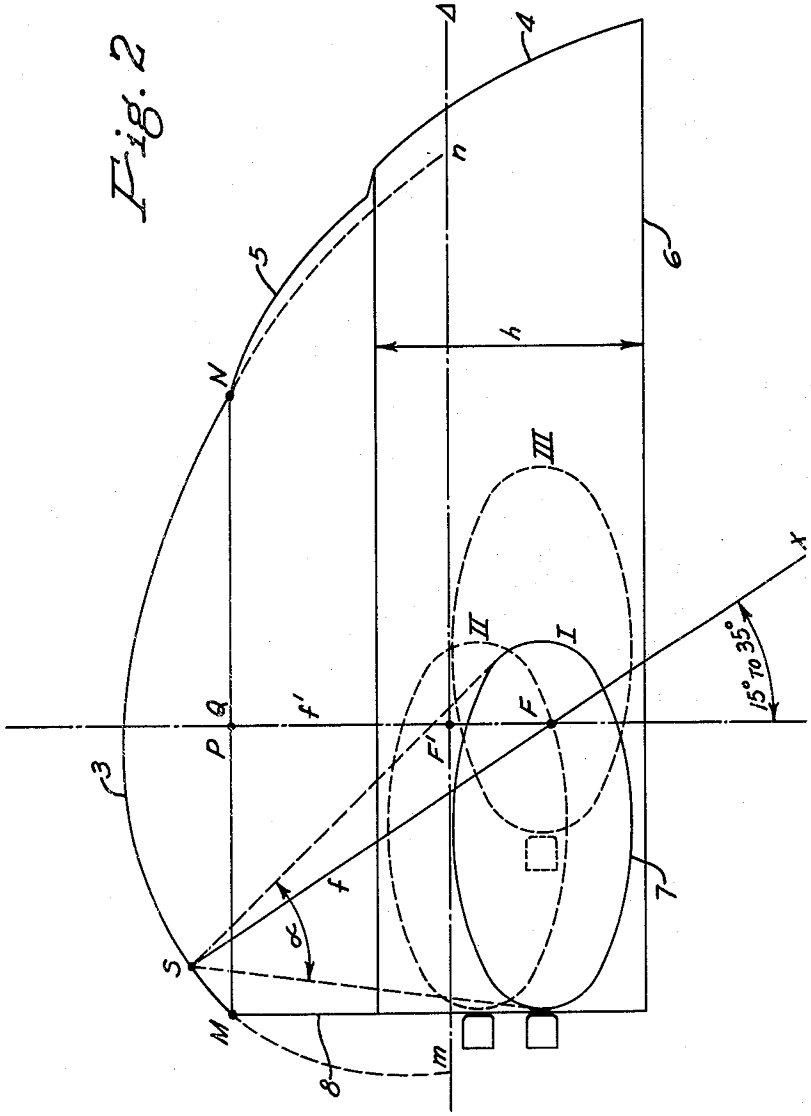
Fig. 2
Δ
4
n
5
6
N
h
III
x
II
I
15° TO 35°
Q
f'
F
P
F'
3
7
f
α
S
M
m
8

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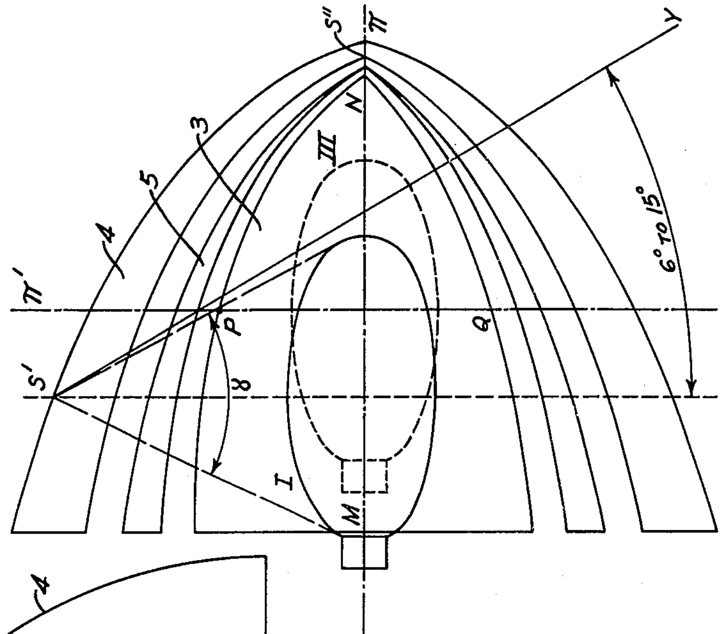

Fig. 4

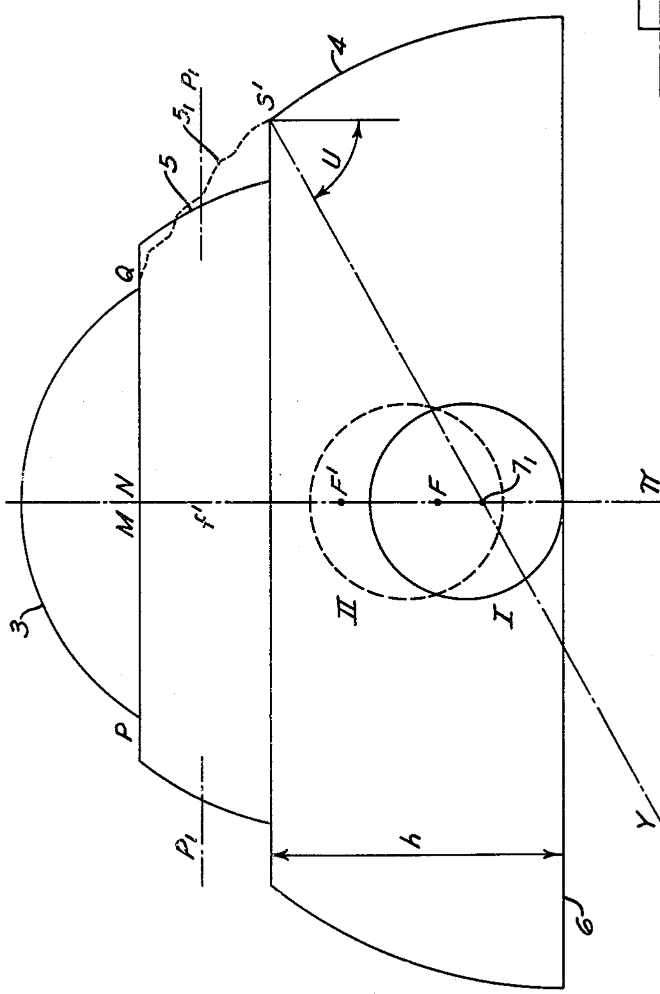

Fig. 3

3,215,980
Patented Nov. 2, 1965

3,215,980

REFLECTING DEVICE FOR PUBLIC STREET LIGHTING APPLIANCES AND LIGHTING APPLIANCES FITTED WITH THIS DEVICE

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Filed Jan. 14, 1963, Ser. No. 259,766
Claims priority, application France, Jan. 17, 1962, 885,132, Patent 1,310,979
8 Claims. (Cl. 240—103)

In most cases, the rational laying out of public street lighting installations consists of placing them at a certain height along the the street and laterally to the latter, in one row (or in two parallel rows enclosing the street when the latter is very wide).

For lighting the street of a town thorofare, installations are sometimes placed on the fronts of bordering buildings. Now the lighting appliances utilized up till now generally comprises an optical system giving two perpendicular symmetrical planes, of which one makes a mark on the ground parallel to the longitudinal axis of the street.

This symmetry plane is also the one for the luminous flux distributed by the appliance.

So that the maximum of luminous flux profitably reaches the street, the optical system of these lighting appliances requires to be sloped (and the appliances themselves generally sloped) by raising them so that the symmetry plane whose mark is parallel to the longitudinal axis of the street is also as near as possible to this axis.

Owing to this, the traces of light beams on the fronts of bordering buildings, in front of and behind the light, are at different heights. These traces, which, moreover, have curves of hyperbolic behaviour reach or even go beyond the summit of the fronts in front of the lights and only reach the lower part of the fronts, on the same side as the light.

The luminous flux thus directed on fronts is, on the one hand, annoying for the adjacent inhabitants, and on the other, partially lost for lighting up the street itself. Moreover, this lighting sets up an awkard environment by the dissymmetry of the lighting of the fronts.

Also, when use is made of lighting sources that are not pin-points or nearly pin-points, the rays reflected coming from the reflector strike on the lamp and are absorbed, which represents a relatively considerable loss of luminous flux.

On this account, for most of the known optical systems, the lighting output, i.e., the ratio between the luminous flux coming from the optical system and the total luminous flux emitted by the naked lamp is a direction function of the ratio between the surface of the optical system and the apparent surface of the lamp.

On the other hand, for affording proper lighting of a street it is necessary to adapt the photometric distribution of the appliance to the optical characteristics germane to the coating forming the surface of the street, so as to give a good balance of illumination on the ground both on any longitudinal axis as well as on any cross axis.

In this connection, the present invention has the object of producing a reflecting device enabling a utilization of the light emitted to be obtained.

Another object of the invention is to produce a device which takes up little space while affording a sound balance of lighting effects on the ground.

Another object of the invention is to define geometrically the shape of the reflecting device as well as the position of the foci of each of the curves forming it.

Other objects and advantages of the invention will be revealed in the following description, the claims attached

at the end of the description, as well as the attached drawings, in which:

FIGURE 1 shows in a diagrammatical manner the lines forming the luminous flux emitted by a reflecting device;

FIGURE 2 shows a section of a reflector along its longitudinal symmetry plane;

FIGURE 3 is a cross-section of this reflecting device;

FIGURE 4 shows the various surfaces of the reflector projected on a plane.

A reflecting device according to the invention is intended to be used chiefly with lamps called "fluorescent." However, it is perfectly adapted to the utilization balloon-shaped opalescent or glassy lamps or any other kind.

In FIGURE 1, the reflecting device F comprising a lighting source is attached to the top end of a post **1** inserted in the ground at the side of the street. This street is limited in this figure by two parallel lines 2_1 and 2_2.

In this FIGURE 1, only half the luminous flux is shown emitted by the reflector F, the other half being symmetrical in relation to the plane π which is the transversal plane perpendicular to the street and passing through F.

The chief photometric plane of this optical device is formed by a plane passing through the horizontal straight line D_1 and parallel to the longitudinal axis of the street and through the point M which is the impact point on the ground of straight line F.M., showing the maximum luminous intensity ray of the plane π (the planes π and π'' are planes cutting the street along different angles and passing through a straight line D orthogonal to the axis of the street).

The reflector F comprises three distinct geometrical parts, inseparable, with regard to general effects. In consists of a dome **3** with a main surface or reflecting band **4** and an intermediate surface or reflecting band **5**.

The dome **3** is situated at the upper part of the reflector and its role is to reflect the luminous flux towards the area of the street situated under the vertical of the light and in its immediate vicinity (up to about 25 to 40° in relation to the vertical).

The main surface is itself made of the greatest reflecting surfaces, and is intended to send the luminous flux as far as possible from the vertical of the optical system in the longitudinal direction of the street. This main surface is situated at the lower part of the reflector near to its base plane **6**.

This main surface is responsible for distributing the luminous flux reflected beyond a plane passing through the straight lines D (FIGURE 1) and Sy (FIGURE 3) and sloped by about an angle U making 60° to 80° in relation to the vertical.

The intermediate surface or surfaces connect the dome **3** to the main surface **4** and are responsible for distributing the luminous flux between the two dihedrals of the dome and main surface.

In FIGURE 2, the reflector is shown along a section of the plane π FIGURE 1. The intersection of the plane and dome **3** is a parabola of focus F, of f focal distance, S summit, Sx axis sloping on the vertical of an adequate angle; this angle can, for example, be comprised between 15 and 35°.

This parabola in the longitudinal direction enables the maximum density of the flux to be displaced towards the axis of the street so as to ensure a satisfactory balance of lighting effects on a cross-road.

This parabola of the dome **3** is limited on the side of the support at point M so that the non-emitting and opaque parts of the lamp **7**, presumed horizontal, are outside of the reflector.

In this way, the lamp **7** is offset toward vertical line **8** in FIGURE 2 in relation to the central area of the reflector, so that for one and the same ratio between the occulted flux by the lamp and the luminous flux coming from the reflector, the volume of this reflector is smaller than that of the conventional reflector.

The reflector according to the invention is thus economical in this respect.

This parabola limited on the rear side of the reflector at point M is limited on the street side at point N, either by the geometrical construction of the dome or by the dimensions required to be given to the reflector.

The parabola MN is considered to be the directive curve of the dome and the surface of the dome is produced by a family of parabolas, whose summits or apices bear on the directive MN, which are made in the plane of FIGURE 3, and where the site of the foci is a straight line Δ (FIGURE 2) horizontal and passing through the point F′ (the point F′ is the focus of one of the parabolas situated on the vertical containing F).

The focal distance f' of this parabola is variable in all circumstances, and less than the focal distance f of the parabola MN.

The distance FF′ from the focus of the parabola MN of the dome to the focus of the generative vertical parabola of this dome is always comprised between the diameter and the maximum radius of the non-pin-point source of light for which the reflector is utilized.

The divergence sought for the dome **3** is limited at points P and Q (see FIGURE 3) in the chief photometric plane, as described above.

This dome thus made is responsible for the distribution of the luminous flux reflected in the main photometric plane from the vertical up to 35 to 40° on either side of this vertical.

The reflector (see FIGURE 2) can be limited on the side opposite to the street by a vertical part **8** limited at its upper part by the point M.

The lamp **7**, presumed horizontal, has its cap towards the rear of this reflector, i.e., on the support side **1**. This lamp is mounted on the reflector so as to be able to move and thus enable the luminous flux to be regulated for adapting it to the lighting of the street in question.

This lamp can first of all move horizontally (see the positions I and III of FIGURE 2).

Thus, without raising the reflector, which remains in such position that its base plane is horizontal, it can firstly direct the maximum flux on to the street and on to its immediate vicinity and then considerably limit the luminous flux striking on the faces of adjoining buildings, these faces moreover, being symmetrically illuminated.

The luminous flux can be offset (in actual practice, the chief photometric plane) either towards the side opposite to the support (position III), or towards the support side (position I).

In the case of position III, the appliance has a high utilization coefficient, while remaining horizontal.

This result also enables the flux to be considerably limited that strikes on the faces of the adjoining buildings opposite to the foci and symmetrically to light up the buildings bordering the street.

In the case of position I, a suitable raising of the appliance will enable the maximum flux density to be approached towards the longitudinal axis of the street.

This position I is provided for cases where local conditions may require the using of sloped appliances, like the traditional ones.

As stated above, the fact of the offset position of the lamp **7** in relation to the central area of the reflector, it occurs that, for the same ratio between the flux occulted and absorbed by the lamp and the luminous flux coming from the reflector, the volume of this reflector is smaller than that of the conventional reflector.

If we refer to FIGURE 1 and consider the spread α, in the plane π for example, the luminous rays are comprised in the angle aFb, but these rays do not all have the same intensity.

If FM is the maximum luminous intensity ray of the plane π and if in the same condition FM′ and FM″ are the maximum luminous intensity rays in the planes π' and π'', the transversal uniformity of lighting effect will be the better effected (for the coating of a given street) if the site of the points M, M′ and M″ is a straight line parallel to the longitudinal axis of the street and as near as possible to this axis.

Consequently, the horizontal displacement of the lighting source **7** in the reflector and the adequate slope of this reflector in relation to the horizontal enable the sites to be ascertained of the points M, M′ and M″ as being on a continuous line in a longitudinal strip, which is central **9**, of the street whose width is about $L/3$, L being the width of the street and being approximately equal to the height H of the reflector on the side of this street.

As it is known that one of the conditions of good lighting is the obtaining of light effect balances in the longitudinal direction, this is obtained in function of the type of covering with a reflector according to the invention by regulating the position of the lamp **7** in the reflector by a vertical displacement. This longitudinal uniformity actually depends on the photometric characteristics of lighting appliances as well as the optical characteristics of the covering of the street.

Now, the adapting of the luminous flux coming from the reflector to the kind of coating leads to making a variation, more particularly, in the luminous intensity of the flux, which falls on the area of the street situated under the vertical of the reflector or in its vicinity. This is obtained by a vertical displacement of the lamp.

Actually, if we imagine that the lamp is in its position I of FIGURES 2 and 3, the volume formed by the balloon of the lamp embraces the focus F of the directive parabola (MN) of the dome but does not embrace any of the parabolas contained in the planes parallel to that of FIGURE 3.

In these conditions, in the Sx direction, the mirror acts as a projector and this in all the planes parallel to the plane of FIGURE 2.

Actually, the reflecting part of the dome **3** which "works" in this case is a strip MN long (FIGURE 2) whose width is part of the distance PQ (see FIGURE 3) at least equal to the maximum diameter of the balloon of the lamp **7**.

If we now imagine that the lamp **7** is displaced upwards by bringing it from position I to the position II so that it embraces not only the focus F, but also all the foci such as F′, the dome of the reflector will act as a projector over all its surface in the direction Sx.

Seeing that the luminous intensity emitted is partially proportional to the emitting surface, we can obtain, according to the position given to the lamp, not only variable intensities, but also intensities that can be regulated according to the user's requirements.

The main surface of the reflector is situated at the base of the reflector and has the object of reflecting the luminous flux as far as possible along the axis of the street.

This main surface is separated from the done **3** by the intermediate surface or surfaces **5** which will be subsequently analyzed.

This main surface is made up of two symmetrical parabolas (in relation to the plane π) each of these paraboloids being such that its foci are embraced by the balloon of the lamp **7** when the latter is in its lowest position.

Each of these two paraboloids forming the main surface of the reflector has the following three particularities:

In the first place, the axis S′y or the plane containing the main parabola is sloped at about 35° to the minimum (80° to the maximum) on the vertical plane π so that this projection S′y on a plane of FIGURE 3 passes through the center of the projection circle 7_1 of the balloon of the lamp **7** and this for the lowest position of the lamp **7**.

Thus, the focal distances of these paraboloids forming the main surfaces are greater than f which is the focal distance of the directive parabola MN of the dome **3**.

Also, the projection on a horizontal plane (see FIGURE 4) of the axis S'y is a straight line sloped at **6** to 15° in relation to a horizontal straight line parallel to the longitudinal axis of the street.

These three conditions enable it to be established that it is in the direction S'y that the luminous flux has its maximum intensity.

The angle γ (on which, in the plane π' we see the balloon of the lamp **7** from S') is equal to the opening angle of the luminous pencil of rays.

If we now consider the angle α (see FIGURES 1 and 2) under which we see the balloon of the lamp in the plane π and from S (see FIGURE 4), this angle is also the opening angle of the pencil of rays reflected in the plane π.

Owing to the fact that by conceiving "f" to be the focal distance of the directive parabola of the dome and is less than the focal distance of the main surfaces, it results that γ is less than α. We have thus a spread in the planes π, π', and π'' which vary in the same direction as the angles α_1, β_1, and γ_1 under which we see the street from the fixing point of the reflector.

The angle α defined above must at least be equal to 45° (on account of H#L) and exceed this value as little as possible when the lamp passes from the position I to the position II.

This ensures that α must be as near as possible to $\alpha_1(\beta\#\beta_1$ and $\gamma\#\gamma_1)$ which is the angle under which we see the street from the luminous focus.

This achievement thus enables us to obtain a luminous flux of which the greater part reaches the street and does not annoy the adjacent inhabitants of this street.

The two paraboloids forming the main surface can, for example, be made of revolution paraboloids.

We have seen that the main photometric plane shows that the dome is responsible for luminous intensities between the vertical and 35° to 40°, whereas the main surface is responsible for luminous intensities in the dihedral limited by the planes passing through D and respectively sloped by 55/60 to 80° in relation to the vertical.

We must thus photometrically fill up the area situated between the two dihedrals containing the flux reflected by the dome and main surface; this is the role of the intermediate surfaces.

Each intermediate surface is formed by two symmetrical paraboloids in relation to the plane π and each of these paraboloids has parameters (focal distance, orientation of the axes) whose values are intermediate between those corresponding to the directive parabola of the dome and those of the paraboloids of the main surfaces.

The reflector can comprise a more or less large number of intermediate surfaces, all these intermediate surfaces being made by paraboloids whose parameters vary in a continuous manner while ensuring the photometric and mechanical connection between the main surfaces **4** and the dome **3**.

In the case of an embodiment similar to 5_1 of FIGURE 3, the intermediate surfaces are connected to each other by regulated taking-up surfaces.

However, in the method of embodiment comprising an infinity of intermediate surfaces (reference 5_1 of FIGURE 3), this surface occurs by a left-hand covering surface of the intermediate surfaces.

The method of connecting the three constituent elements of the reflector is such that the projection on a horizontal plane (FIGURE 4) is an assembly of curves and/or straight lines without relationship between them, but converging.

Of course, the invention is not limited to the examples of embodiment described and shown above, for which other methods and forms of embodiment can be provided without going outside of the scope of the invention for that purpose.

What I claim is:

1. Reflecting device for public lighting appliances comprising a combination three geometrically distinct parts forming a dome at the top part having means for reflecting the luminous flux in the area adjacent to the vertical of the reflecting device, a main surface on the lower periphery of the device having means for distributing the flux in the more distant areas situated between the foci, an intermediate surface having means for the distribution of the luminous flux between the fluxes reflected by the dome and the main surface, said dome and surfaces being connected together as a unit, means for supporting a lighting source in the lower part of the device, the bottom of said device lying in a base plane, the top part of the dome being defined in planes parallel to the longitudinal axis of the street by parabolas, the foci of these parabolas being situated on a line that is parallel to said base plane and outside the volume occupied by the lighting source, the dome also being defined in the vertical symmetry plane of the appliance by a parabola, the focus of said last-mentioned parabola being situated inside the volume occupied by the lighting source and the curve representing said last-mentioned parabola being the loci of the apices of the first mentioned parabolas, the flux reflected by the dome being contained in a dihedral confined by planes sloped 15° to 35° on either side of the vertical symmetry plane containing the reflecting device.

2. Reflecting device for public lighting appliances comprising in combination three geometrically distinct parts forming a dome at the top part having means for reflecting the luminous flux in the area adjacent to the vertical of the reflecting device, a main surface on the lower periphery of the device having means for distributing the flux in areas more distant situated between the foci, an intermediate surface having means for the distribution of the luminous flux between the fluxes reflected by the dome and main surface, said dome and surfaces being connected together as a unit, means for supporting a lighting source in the lower part of the device, the bottom of said device lying in a base plane, the top part of the dome being defined in planes parallel to the longitudinal axis of the street by parabolas, the foci of these parabolas being situated on a line that is parallel to said base plane and outside the volume occupied by the lighting source, the dome also being defined in the vertical symmetry plane of the appliance by a parabola, the focus of said last-mentioned parabola being situated inside the volume occupied by the lighting source and the curve representing said last-mentioned parabola being the loci of the apices of the first-mentioned parabolas, the flux reflected by the dome being contained in a dihedral limited by planes sloped at 15° to 35° on either side of the vertical symmetry plane containing the reflecting device, a vertical part limiting the rear side of the surface of the dome, and receiving means for fixing the lighting source.

3. A public lighting appliance comprising an elongated downwardly opening concave reflector adapted to be supported above one side of a street with the central vertical longitudinal plane of the reflector substantially transverse to the street, the reflector having a downwardly reflecting dome at its top surrounded by an intermediate reflecting band that connects the lower edge of the dome to the upper edge of a main reflecting band extending around the lower edge of the intermediate band, a balloon-shaped lamp disposed in the reflector in the area surrounded by the main band and near the end of the reflector away from the street, and lamp-supporting means connected to said end of the reflector, the intersection of the dome and said plane forming a parabola extending lengthwise of the reflector and having its focus within the lamp, the dome also being in the form transversely of parabolas intersecting at their apices said first-mentioned parabola at right angles thereto and having their foci along a line extending lengthwise of the reflector above said focus, and each of said reflecting bands being in the shape of a pair of paraboloids symmetrical with reference to said plane, the intermediate reflecting band being positioned to illuminate the area of the street at each side of said plane between the areas illuminated by said dome and main reflecting band.

4. A public lighting appliance according to claim 3, in which said line of foci is above said lamp.

5. A public lighting appliance according to claim 4, in which said lamp can be raised in the reflector to surround some of said line of foci in addition to said dome focus.

6. A public lighting appliance according to claim 3, in which the foci of the paraboloids of said main reflecting band are within said lamp.

7. A public lighting appliance according to claim 3, in which the focal distance of the paraboloids of said main reflecting band is greater than the focal distance of said parabola, and the focal distance of the paraboloids of said intermediate reflecting band is a length intermediate said focal distance of the paraboloids of the main reflecting band and said focal distance of said parabola.

8. A public lighting appliance comprising an elongated downwardly opening concave reflector adapted to be supported above one side of a street with the central vertical longitudinal plane of the reflector substantially transverse to the street, the reflector having a downwardly reflecting dome at its top surrounded by an intermediate reflecting band that connects the lower edge of the dome to the upper edge of a main reflecting band extending around the lower edge of the intermediate band, a balloon-shaped lamp disposed in the reflector in the area surrounded by the main band and near the end of the reflector away from the street, and adjustable lamp-supporting means connected to said end of the reflector for adjusting the position of the lamp in the reflector, the intersection of the dome and said plane forming a parabola extending lengthwise of the reflector and having its focus within the lamp, the dome also being in the form transversely of parabolas intersecting at their apices said first-mentioned parabola at right angles thereto and having their foci along a line extending lengthwise of the reflector above said focus, and each of said reflecting bands being in the shape of a pair of paraboloids symmetrical with reference to said plane, said dome being shaped to reflect luminous flux in a dihedral limited by planes sloping from 25° to 40° away from both sides of said vertical plane, said main reflecting band being shaped to reflect luminous flux at each side of said vertical plane in a dihedral limited by planes sloping substantially 55° and 80° away from the vertical plane, and said intermediate reflecting band being shaped to reflect luminous flux into the space between said dihedrals.

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NORTON ANSHER, *Primary Examiner.*

EVON C. BLUNK, *Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,215,980 November 2, 1965

Marie Henri Hubert Adam

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 14, strike out "the", second occurrence; line 20, for "comprises" read -- comprise --; line 41, for "awkard" read -- awkward -- column 2, line 13, after "utilization" insert -- of --; line 28, for "planes π" read -- planes π' --; line 33, for "In" read -- It --; line 57, before "FIGURE" insert -- of --; column 4, line 62, for for "done" read -- dome --; column 6, line 7, for "a" read -- in --.

Signed and sealed this 25th day of October 1966.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents