March 21, 1950 B. J. PIQUÉ 2,501,140

ELECTRIC-LIGHT PROJECTING REFLECTOR

Filed Oct. 17, 1947

FIG. 1

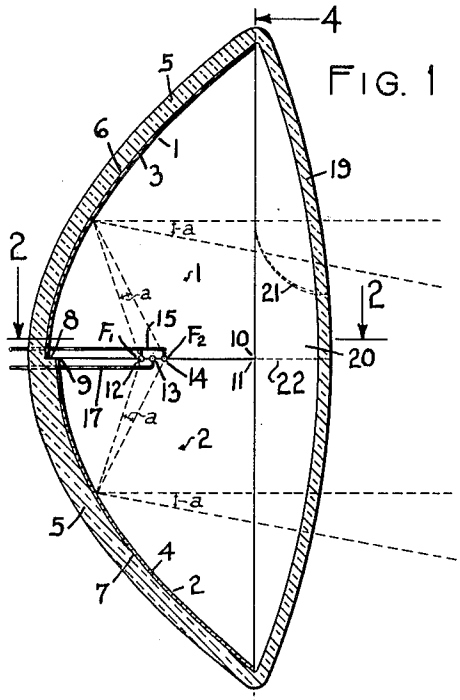


FIG. 2

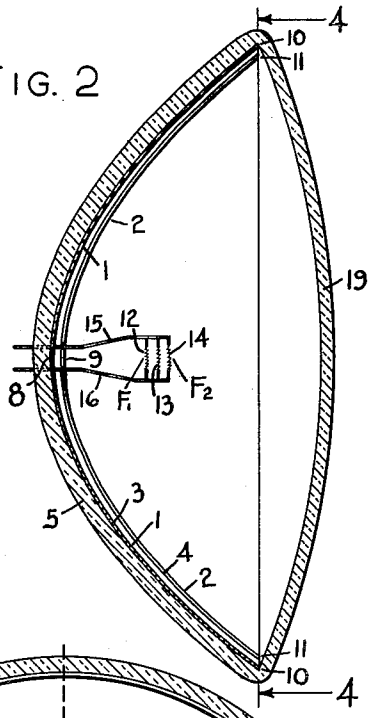


FIG. 3

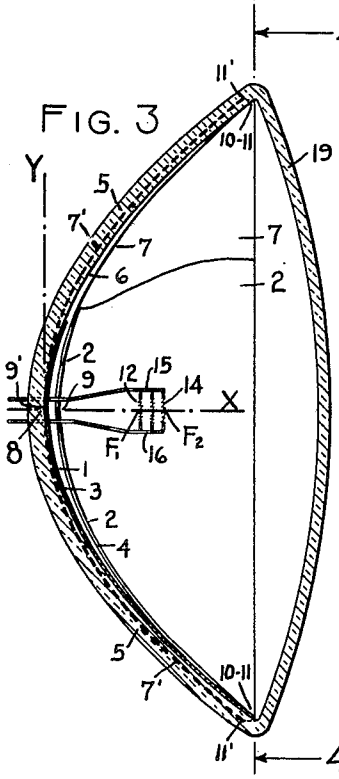
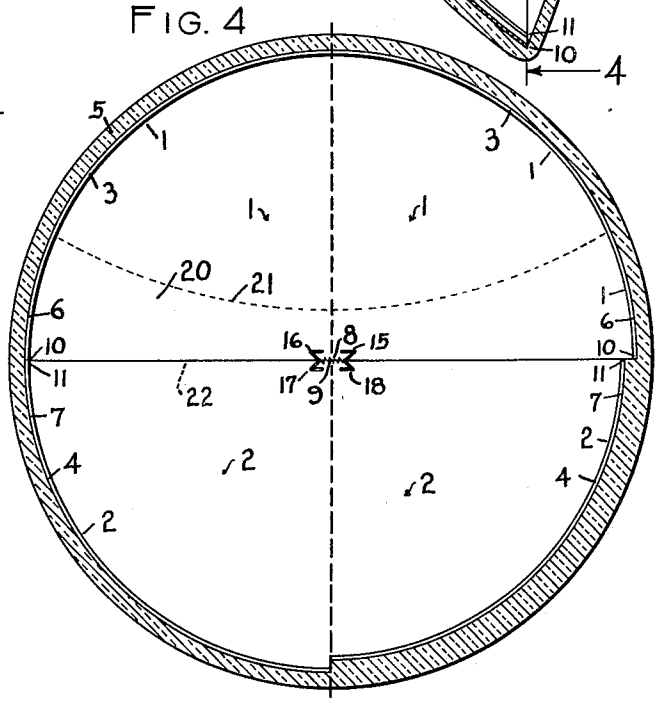


FIG. 4



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ELECTRIC-LIGHT PROJECTING REFLECTOR

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3 Claims. (Cl. 176—34)

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My invention relates to an electric-light projecting reflector which comprises an arrangement to project a pencil of bright beams limited horizontally at the top and diverging uniformly downwards; means to dim and diffuse the direct light rays from the light source to an exterior zone comprised between the upper-limit of the divergent pencil and a definite angle over said limit; and means to change the divergent pencil, projecting it merely to the central zone of divergence.

More particularly my invention relates to an electric light projecting device which comprises a compound light source constituted by three single light sources adapted to fulfil two functions in conjunction with two displaced focal points related in combination with a true paraboloidal light concentrating surface having the lower-half part displaced forwards; and a cover glass constituted with a determined part made frozen and colored from its horizontal central line to a definite curve line over said central line.

One of the advantages of such light projectors is that they may be made commercially practicable to provide safety headlamps for use on automobiles, trucks, airdromes, etc. Another advantage is possible to change the action of the compound light source, reducing the projected field of such divergent pencil of bright beams.

Another advantage of this light projector is the adaptation of a cover glass constituted with a determined part made frozen and colored, apt to diminish the direct light rays, from the light source, that passing through it attain an exterior zone of diffused light comprised between a horizontal plane and a definite angle over the horizontal plane.

Light projectors have heretofore been disclosed in which the reflecting surfaces are different curves to project the beams in desired direction, but these compound surfaces are objectionable because wrought surfaces are not as extremely accurate as a surface made in physical process as the paraboloid, and distortion of the reflected light beams are obtained.

It is known that the best concave surface produced with extreme accuracy is the paraboloid of revolution, because when a liquid body is contained in a receptacle which rotates uniformly, the surface of the liquid takes the form of an accurate paraboloid. The natural surface of liquids in absolute or relative state of repose are extremely accurate. When this liquid is due to a solid body in fused condition by heat, and is contained in a receptacle which rotates uniformly,

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and then being cooled slowly while continuing at the same angular velocity, the liquid body takes the solid form of the paraboloid as the pattern. This pattern, with the accurately formed paraboloidal surface, may be cut asunder through a plane holding the axis of the paraboloid, and then both halves may be joined with the displacement required to both focal points. Taking from such pattern the curvature of the surface of the plunger of the pressing apparatus, the reflector section or displaced paraboloidal portions may be made with extreme accuracy by pressing, particularly when made of a glass having a low coefficient of expansion, such as that commercially known as "Pyrex" and described and claimed in the United States Patent No. 1,304,623, Sullivan et al., issued May 27, 1919.

Until now, the light projectors have been proposed with the filament centered at the focus of the paraboloidal reflecting surface, it is correct, however, when the middle of filament coincides with the focus, it has a half part at each side of said focus, and the light rays coming from the front part of the filament to the lower-half part of the paraboloidal reflecting surface are reflected inclined upward, and the light rays coming from the back of the filament to the upper half part of the paraboloidal reflecting surface are reflected inclined upward. These light rays reflected inclined upward, and the direct light rays inclined upward from the filament, present an obstacle in the way when their are lit with intensity.

One of the objects of my invention is to provide means in an adaptation for light projectors in which the above-mentioned disadvantages will be avoided.

Another object of my invention is to provide a compound light source constituted by three single light sources, as filaments or any other sources, one of them centered and connected independently; these three single light sources are positioned transversely on the same horizontal plane, and located with its width inter-limited between two focal points displaced jointly with the upper and lower halves parts, respectively, of a true paraboloidal light-concentrating surface; where from this arrangement will project a divergent pencil of bright beams limited horizontally at the top and diverging uniformly downwards; furthermore, when the centered light source is lit alone, the divergent pencil will be projected only to the central zone of divergence.

A further object of my invention is the provision of a cover glass constituted with a determined part made frozen and colored from its horizon-

tal central line to a determined upper curve line, apt to dim the diffuse the direct light rays from the light source to an exterior zone comprised between the horizontal upper limit of the divergent pencil and a determined angle over said limit.

Other objects and advantages of my invention will appear from the following description with reference to the accompanying drawings, in which Figure 1 is a vertical sectional view of a light projecting device showing my invention comprised in an adaptation; Figure 2 is a horizontal sectional view taken on the line 2—2 of Fig. 1; Figure 3 is the same horizontal sectional view taken on the line 2—2 of Fig. 1, showing another adaptation of the displaced halves paraboloids; Figure 4 is a cross-section view taken on the line 4—4 of Figs. 1, 2 and 3, showing at each side of the dotted line the views according to Figs. 2 and 3, respectively.

Referring to the drawings, particularly Fig. 1, a reflector member 5 having inner preformed paraboloidal surface 6–7, with the lower half part 7 displaced forwards. The said reflector member 5, with the displaced inner surfaces 6 and 7, are preferably made of low-expansion glass, since the plastic glass conforms precisely to the curvature of the accurately formed displaced surfaces of the plunger of the pressing apparatus.

A metallic coating 3—4 applied on the inner surfaces 6—7, to provide the half paraboloidal light-concentrating surface 1 with the geometrical focus at inner point F_1, and the half paraboloidal light-concentrating surface 2 displaced forward in order to advance its geometrical focus to the front point F_2 on the same axis.

The cross-section views taken on the line 4—4 of Figs. 1, 2 and 3, showed in Fig. 4, shows at each side of the dotted line the front view of the paraboloidal reflecting surfaces 1 and 2. The form showed at the right side of the dotted line, from observer, is according to Fig. 2, here the extreme points 10 and 11, of the inner surfaces 6 and 7, are seperated with each other, forming at the front a discontinued ring. And in the form showed at the left side of the dotted line of Fig. 4, is according to Fig. 3, where the two halves surfaces 6 and 7 are displaced from their vertices 8 and 9, and coinciding in the extreme points 10 and 11, forming at the front a circular section.

Up to here, being an adaptation of the complementary parts to combine with the novelty as follows:

A compound light source constituted by three single light sources 12, 13 and 14, which may be three filaments, located horizontally in the same plane of displacement of the displaced surfaces 1—6 and 2—7, and positioned on transversal sections inter-limited in conjunction between both focal points F_1 and F_2. The light source 12 is located with its middle section tangent to the focal point F_1 correspondent to the upper-half paraboloidal surface 1; and the light source 14 is located with its middle section tangent to the focal point F_2 correspondent to the lower-half paraboloidal surface 2; these two light sources 12 and 14 are fixed and connected by means of the conductor members 15 and 16 that are extended to the exterior of the reflector member 5. The light source 13 is located at the middle between the two light sources 12 and 14, and is fixed and connected independently by means of other two conductor members 17 and 18 that are extended to the exterior of the reflector member 5. The middle

sections of the three single light sources 12, 13 and 14, are in the same lineal direction between the two focal points F_1 and F_2.

The compound light source 12—13—14, when if being three filaments should be enclosed in an envelope that is not shown in the drawings, or without envelope if the reflector member 5 were sealed with the cover glass 19 together.

Referring to Fig. 1, all light rays coming from the inner focal points F_1 to the upper-half paraboloidal reflecting surface 1, are reflected horizontally, and all light rays coming from the front focal point F_2 to the same upper-half reflecting surface 1, are reflected downwards. Furthermore, the light rays coming from the front focal point F_2 to the lower-half paraboloidal reflecting surface 2, are reflected horizontally, and the light rays coming from the inner focal point F_1 to this lower-half reflecting surface 2, are reflected downwards. Hence, when the light sources 12, 13 and 14 are lit together, the light rays propagated toward both upper and lower halves paraboloidal reflecting surfaces 1 and 2, will be reflected forming a divergent pencil of bright beams limited horizontally at the top and diverging uniformly downwards. When the centered light source 13 is lit alone, the pencil of bright beams will be propagated solery to the central zone of divergency.

A cover glass 19, constituted with a determined part 20 made frozen and colored, from the horizontal central line 22 to a determined upper curve line 21, showed in dotted line in Figs. 1 and 4.

The direct light rays propagated from the light source to the exterior, in the direction of a determined zone comprised between a horizontal plane and a definite angle over the horizontal plane, will be interfered by the cover glass part 20 made frozen and colored. These light rays that pass through the frozen and colored glass part 20, must be dimmed and diffused, obtaining with it to make in the way a safety high zone of dimmed and diffused light, where it is coming front the opposite driver.

The appropriate color to dim the light with health use is attained mixing the glass part 20 with a proportion of colors of two parts of yellow, one part of blue and one part of red, obtaining a dimmed and diffused light of grayish green color.

The cover glass 19 and the frozen and colored part 20 may be made of low-expansion glass, and thus, them may be welded through the line of joints 21 and 22.

The reflector member 5, with the displaced-preformed interior paraboloidal surfaces 6 and 7, may be made of glass or any other proper material. The paraboloidal halves surfaces 6 and 7 may be made together with the reflector member 5 by a pressing apparatus with accurately formed displaced surfaces. The reflector member 5 with the displaced halves paraboloid 6 and 7, may be made of low-expansion glass.

When the reflector member 5 is made metallic, the displaced interior surfaces 6 and 7 may be the correspondent paraboloidal reflecting surfaces, without the coatings 3 and 4.

The two halves paraboloidal surfaces 6 and 7, with their respectively reflecting surfaces 1 and 2, may have equal focal distances when said surfaces 1—6 and 2—7 are displaced with each other with the same displacement required to the focal points F_1 and F_2 with each other, with respect to the width of the light source.

When both displaced halves paraboloidal sur-

faces 1—6 and 2—7 have different focal distances, the displacement required to said surfaces 1—6 and 2—7 will be according to the relative separation to the focal points F_1 and F_2, with respect to the width of the light source.

As a suitable adaptation, when is desired a greater width of the light source 12—13—14, together with the separation of both focal points F_1 and F_2, and lesser displacement of both paraboloidal halves surfaces 1—6 and 2—7, the upper-half surface must have lesser focal distance than the lower-half surface 2—7; and it is possible to make coinciding the extreme points 10 and 11, at the periphery of the displaced halves surfaces 1—6 and 2—7, having at the front continued ring section. Referring to Fig. 3, and considering a parabolical section 11'—9'—11' of a surface 7', shown in dotted line, with the vertex 9' coinciding at vertex point 8 of the parabolical section 10—8—10 of the inner surface 6. Taking the coincided points 8 and 9' as origen of rectangular coordinates with the X-axis coinciding with the paraboloidal axes. The equations of the two parabolic sections are:

$$Y^2=4P_1X \quad (1), \text{ and } Y^2=4P_2X \quad (2)$$

Where the expression P_1 is the geometric focal distance correspondent to the interior concave section 10—8—10, and the expression P_2 represent the geometric focal distance correspondent to the concave section 11'—9'—11'. Here, the focal distance P_1 must be shorter than the focal distance P_2.

Considering that the extreme point 11' have the same ordinate b as the extreme point 10, and solving both Equations 1 and 2 with the ordinate $Y=b$ we'll have that $b^2=4P_1X_1=4P_2X_2$ (3). From Equation 3 we have that: $P_2/P_1=X_1/X_2$ (4), subtracting the unit at both members

$$(P_2-P_1)/P_1=(X_1-X_2)/X_2 \quad (5)$$

the expression (X_1-X_2) is the distance from the extreme points 11' and 10, one from another.

If the parabolic section 11'—9'—11' is displaced a space (X_1-X_2) from its position to the position 11—9—11, the two parabolic sections 10—8—10 and 11—9—11 will coincide at the extreme points 10 and 11 correspondent to the horizontal joint 10—8—9—11 of the upper-half and lower-half of the reflector member 5. After the displacement of the interior surface 7, together with the reflecting surface 2, the space W comprised between the two focal points F_1 and F_2 must be equal to the width of the light source, here the three filaments 12—13—14. The algebraic expression of W will be:

$$W=(P_2-P_1)+(X_1-X_2) \quad (6)$$

Making the displacement $(X_1-X_2)=\frac{2}{3}W$ (7); from Equations 6 and 7 we will have that $(P_2-P_1)=\frac{1}{3}W$ (8). Substituting these two values 7 and 8 in the Equation 5, we have that $2P_1=X_2$ (9). Eliminating X_2 from Equations 7 and 9, and solving for X_1 value, we have that $X_1=2(P_1+\frac{1}{3}W)$ (10). Substituting this value of X_1 from Equation 10 at the Equation 3:

$$P_1^2+\frac{1}{3}WP_1-\frac{1}{8}b^2=0 \quad (11)$$

Solving by P_1 in this Equation 11, we will have that:

$$P_1=\pm\frac{1}{6}\sqrt{W^2+9/2b^2}-\frac{1}{6}W \quad (12)$$

Eliminating P_1 from Equations 8 and 9, and solving by X_2 value, we have that

$$X_2=2(P_2-\frac{1}{3}W) \quad (13)$$

substituting this value of X_2 from Equation 13,

at the Equation 3: $P_2^2-\frac{1}{3}WP_2-\frac{1}{8}b^2=0$ (14); and solving by P_2 from Equation 14:

$$P_2=\pm\frac{1}{6}\sqrt{W^2+9/2b^2}+\frac{1}{6}W \quad (15)$$

Looking at the Equations 12 and 15, with the real positive values, the general equation of P_1 and P_2 will be:

$$P=\frac{1}{6}\sqrt{W^2+9/2b^2}\pm\frac{1}{6}W \quad (16)$$

P is for P_1 and P_2 values, being b the half diameter of the reflector member 5, and W is the space comprised between the two focal points F_1 and F_2, equal to the width of the light source.

From Equation 9 we see that the focal point F_1 is located at the middle of the reflector member 5.

Let us observe in Fig. 1, that the reflected light rays inclined downwards, form a determined angle a with the horizontally-reflected light rays, increasing said angle a from the vertices 8 and 9 to the upper and lower vertical part of the middle point between the focal points F_1 and F_2, on the reflecting surfaces 1 and 2, respectively, where the angle a is maximum. The maximum angle a on the lower-half reflecting surface 2 is greater than the maximum angle a on the upper-half reflecting surface 1. These maximum values of a are measure of the geometric relation

$$\tan.\, a=\frac{W}{Y_a}\Big/\left(1-\frac{W^2}{4Y_a^2}\right)=\frac{1}{N} \quad (17)$$

$$\frac{1}{N}$$

is the gradient relation of the maximum inclination of the light rays, and Y_a is the ordinate correspondent to the middle point between the focal points F_1 and F_2, where $X_{a1}=P_1+\frac{1}{2}W$ (18), and $X_{a2}=P_2-\frac{1}{2}W$ (19).

Solving for N in Equation 17:

$$N=Y_a/W-W/4Y_a \quad (20)$$

As an example: a reflector of 6 inch of diameter with a light source of ½ inch of width: $b=3''$ and $W=\frac{1}{2}''$. By the Equation 16, $P_1=0.981$ inch, and $P_2=1.147$ inch. By the Equations 1, 18 and 20, $N_1=4.34$ to 1; and by the Equations 2, 19 and 20, $N_2=3.934$ to 1. If the reflector is located at 3 feet over the floor, the maximum-inclined reflected rays will attain the floor at 3x4.34=13 feet, and 3x3.934=11.8 feet, from the reflector.

As a greater width of the compound light source 12—13—14 jointly with the separation of both focal points F_1 and F_2, the pencil of bright beams will diverge downward more amply, obtaining foresaw desired amplitude. Hence, it is not ne[cessary] to use lens here instead of cover glass.

What I claim as new and desire to secure by Letters Patent is:

1. In a light projecting device comprising true paraboloidal light-concentrating surface preformed with the lower half part displaced forward at the same axis in order to have advanced its focal point in relation to the focal point of the upper half part, a light source positioned transversely horizontal with its width inter-limited between both displaced focal points, and a cover glass constituted with a determined part made frozen and colored from its horizontal central line to a definite curve line over the central line, substantially as described to avoid the propagation of direct and indirect light rays inclined upward.

2. In a light projecting device comprising true paraboloidal light-concentrating surface preformed with the lower half part displaced forward at the same axis in order to have advanced

its focal point in relation to the focal point of the upper half part, a compound light source constituted by three single light sources positioned transversely on a same horizontal plane with their width in conjunction inter-limited between both displaced focal points, one of said single light source being centered and connected independently from both other substantially as described to fulfill two independent functions, one projecting a divergent pencil of bright beams diverging uniformly downwards and limited horizontally at the top, and other one projecting the pencil merely to the central zone of divergency.

3. In a light projecting device comprising true paraboloidal light-concentrating surface preformed with the lower half part displaced forward at the same axis in order to have advanced its focal point in relation to the focal point of the upper half part, a compound light source constituted by three single light sources positioned transverselly on a same horizontal plane with their width in conjunction inter-limited between

both displaced focal points, one of said single light source being centered and connected independently from both other, and a cover glass constituted with a determined part made frozen and colored from its horizontal central line to a definite curve line over the central line.

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