July 14, 1925.

1,546,281

S. E. BROWN

REFLECTOR

Original Filed May 16, 1918

Fig. 3.

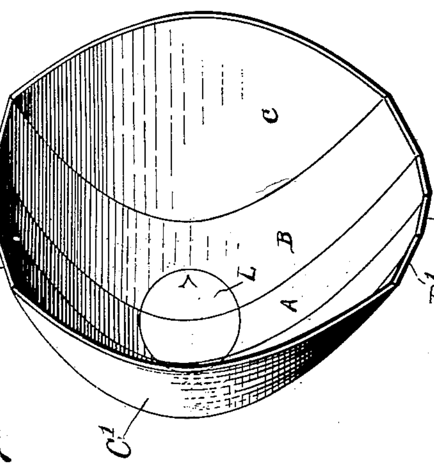


Fig. 1.

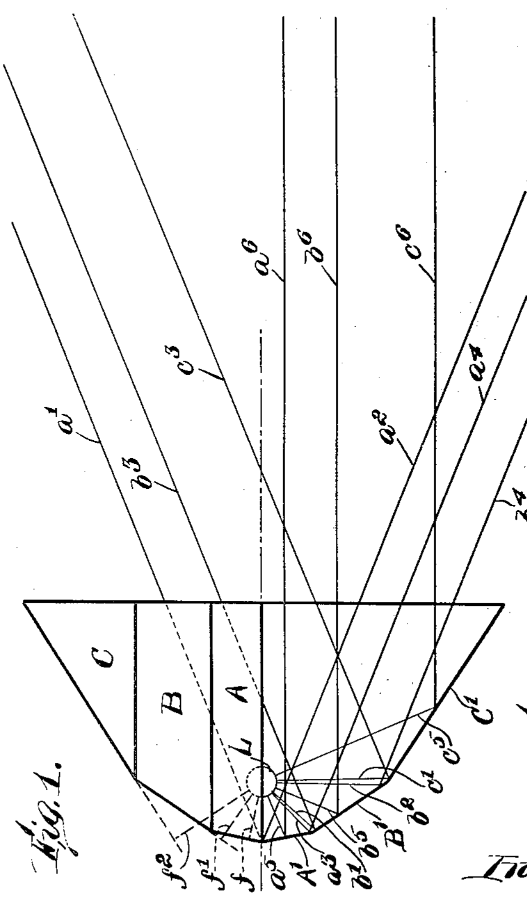
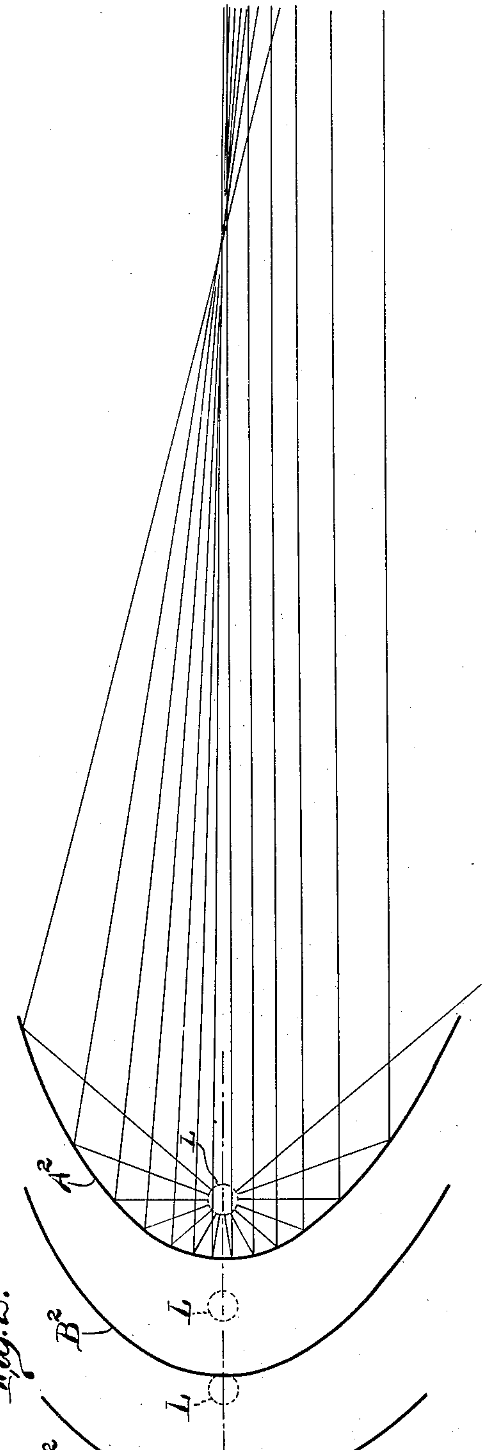


Fig. 2.



Inventor: S. E. Brown

Patented July 14, 1925. **1,546,281**

UNITED STATES PATENT OFFICE.

SUMNER E. BROWN, OF DEDHAM, MASSACHUSETTS.

REFLECTOR.

Application filed May 16, 1918, Serial No. 234,992. Renewed June 16, 1919. Serial No. 304,737.

To all whom it may concern:

Be it known that I, Sumner E. Brown, a citizen of the United States, residing at Dedham, in the county of Norfolk and State of Massachusetts, have invented new and useful Improvements in Reflectors, of which the following is a specification.

This invention relates to reflectors for lamps and is particularly intended to be used in connection with headlights of motor cars. Under the term "lamp" as used in the preceding statement I include all sources of illumination, whether the same be an electric arc, an incandescent filament, a flame, or any other means which may be availed of to produce light. And in describing the invention as particularly adapted for the headlights of motor cars, I do not intend to imply any restriction as to the field or scope of its use, but on the contrary I intend to protect the invention as applied to a reflector used in any connection where the reflection of light in a relatively concentrated beam is desirable.

The main object of the invention is to embody in the construction of the reflector means for securing a certain predetermined spread of light in one plane while maintaining a sufficient concentration of light in the plane at right angles thereto. More particularly, as applied to a headlight reflector for automobiles and other traveling vehicles, my object is to secure a given horizontal spread of light, whereby to illuminate sufficiently objects at the sides of the highway or road and avoid concentration of all of the reflected rays in a narrow beam of too great intensity; and to accomplish this result without at the same time causing an unnecessarily great vertical spread of reflected light, and particularly without throwing reflected rays upwardly.

The invention consists essentially in forming the reflector in a number of different reflecting surfaces or panels, which for convenience of this description I will call zones so arranged with respect to the source of light as to reflect rays with the desired lateral spread, and are otherwise so formed as to effect the desired concentration in the plane at right angles to that in which such spread occurs.

In the drawings wherein I have illustrated the invention, Figure 1 represents partly in plan and partly in horizontal section an embodiment of my invention in a position adapting it to the uses of an automobile headlight reflector where spread of light horizontally and avoidance of light spread upward are desired, said figure showing also diagrammatically the manner in which light is reflected with horizontal spread. Figure 2 is a diagram representing sections on vertical planes of the several zones of the reflector, and showing also the directions in which light rays are reflected in the vertical plane. Figure 3 is a front elevation of the reflector as viewed from a direction approximately at an angle of 45° to the vertical median plane.

In order most clearly and concisely to explain the principles of the invention, I will describe the embodiment thereof in a reflector designed for automobile headlights to secure horizontal spread of light without vertical spread; and in connection therewith will explain the reason for and the utility of the invention.

In the development of headlight reflectors for automobiles, attention has been first directed to securing concentration of the reflected rays so as to give bright illumination to the road in front of the car, and next to the elimination of high rays so as to avoid dazzling the eyes of drivers approaching the light. While these effects have been efficiently accomplished, their accomplishment has been accompanied with the result of so narrowing the field of illumination and so brilliantly illuminating the road in front of the light as to intensify the darkness outside of the illuminated field, and this has given rise to the danger that the driver of the car, whose eye has become accustomed to the bright illumination in front and thereby made less receptive to feeble light rays coming from outside the illuminated field, will not perceive persons about to step heedlessly in front of the car, and has actually been the cause of many accidents. In the effort to avoid accidents from this cause, various devices for diffusing the light have been produced, but so far as I am aware such devices have also resulted in loss of efficiency in the projection of the desired illuminating rays, and have not confined the dispersion to the horizontal plane, which alone is necessary, but have diffused light in all directions, which is objectionable.

I have accomplished the desired result of spreading the light laterally without at the same time unavoidably spreading it vertically or emitting brilliant high rays, and without loss of efficiency, by making the reflecting surface in a plurality of panels or zones, which are segmental, substantially cylindrical, concave surfaces, and of which the inclination of their elements with respect to the rays of light emanating from the lamp, and their respective widths are of the required values to cause such lateral spread as is required for a given case. Referring to Figure 1 it will be seen that the reflector is symmetrical on both sides of a vertical central plane, and that on one side of said plane it is formed with zones A, B, and C, and on the other side of the plane with zones A′, B′, and C′. Such zones are segments of cylindrical surfaces, by which I mean that they are segments of curved surfaces each of which is generated by a moving straight line which continually touches a given curve, and in all of its positions is parallel to a given straight line not in the plane of the curve. The elements of each surface so generated correspond to different positions of the generating line, and all such elements are parallel to one another. That part of Figure 1 which is in section shows the elements of the zones in the horizontal medial plane of the reflector, that is, the horizontal plane which passes through the lamp or point of illumination. The cylindrical surface thus defined need not be the surface of a right cylinder, but may fit the outline of a curve of any form; and the bounding edges of the zones need not be perpendicular to the elements of such surfaces, but must actually be variously inclined to such elements, as shown in that part of Figure 1 which represents a plan view, in order that the zones may be matched together.

The widths of the several zones and the angles which their elements make with the vertical median plane may have many values, and are determinable in accordance with the limit of size of the reflector and the width of light spread desired. The practical limiting factors to the size of the reflector are the permissible diameter of the headlight casing and the distance which must intervene between the lamp and the nearest point of the reflector. The position of the lamp or other light source is indicated at L in Figure 1.

In the embodiment chosen for illustration it has been assumed that the horizontal spread of the reflected light desired is 45°, that is 22½° to each side of the vertical medial plane. Therefore the zones have been laid out of such width and with their surface elements horizontal and at such inclinations to the vertical plane that the rays from the lamp reflected from the opposite edges of each zone will be reflected with this degree of spread. Referring for example to the zone B′ of Figure 1, the line b' indicates the ray from the lamp which strikes the edge of zone B′ nearest to the central plane. This ray is reflected along the line b^3 22½ degrees to the left of the axis. The ray b^2 from the lamp striking the outer edge of the zone B′ is reflected along the line b^4 22½° to the right of the axis. The rays which are reflected from the adjacent edges of the zones A and A′ are reflected on diverging lines a' and a^2, which make the angles above indicated with the vertical medial plane and are consequently parallel to the rays b^3 and b^4, respectively, it being understood, however, that the reflected ray a' is reflected from the zone A′ and that the ray a^2 is reflected from the zone A. The ray a^3 from the lamp striking the remoter edge of the zone A′ is reflected on the line a^4 parallel to the reflected rays a^2 and b^4. In like manner the ray indicated at c' which strikes the nearest edge of the outermost zone C′ is reflected on the line c^3 parallel to b^3 and a'. The opposite limiting reflected ray from the zone C′ is not shown because the limiting outer dimension of the reflector forbids this zone being carried out to the point where a ray from the lamp would be reflected at so large an angle as 22½°. The lines a^5, b^5, and c^5 represent the light rays, which, striking the several zones, are reflected straight ahead, and the reflections thereof are shown at a^6, b^6 and c^6, respectively. It will be understood that the rays striking the zones A, B, and C are reflected in an equivalent manner but in the reverse order to that described. All the reflected rays, that is the rays reflected from all of the several zones, are within the limits of spread of the beam of rays hereinbefore described. Thus each zone reflects rays in a fan, and such rays reflected from different zones occupy in part the same field. To the spreading fan of light composed of the reflected rays is added the light of direct rays issuing from the lamp, all of which gives sufficient light to make visible objects and persons at the sides of the road a short distance ahead of the car, enabling the driver to see them in time to avoid accidents. This effect is secured without undue spread of light, without loss of efficiency, and without diminishing the concentration of light in the center of the illuminated field below the degree necessary for making the road ahead clearly and easily visible.

Evidently the result accomplished as described depends upon the law of optics that the angle of reflection of light is equal to the angle of incidence of the ray upon the reflecting surface. Therefore by arranging the elements of the reflecting zones at the proper angles to the rays which impinge on them from the lamp, and making the zones of the proper width in accordance with this law, a spread of light of any desired angle, either greater or less than that herein shown and described for illustration, may be obtained.

The best and most exact results according to the principles of this invention are produced when the reflecting zones are true cylindrical surfaces, that is when the elements thereof are straight lines, but approximating results may be had even though the zones are not exactly cylindrical within the definition previously given. Therefore I do not restrict my claim to protection to a construction in which the zones are exactly cylindrical, but include all constructions embodying substantially cylindrical reflecting zones.

In the vertical planes the reflecting zones may have any curvature adapted to cause such reflection and deflection of light as may be desired. Thus in Figure 2 I have shown a form of curvature which may be given to each of the zones, and is effective to reflect the lower rays straight ahead and to reflect the upper rays from the lamp downwardly in order to illuminate the road far ahead and eliminate high rays which would have a tendency to dazzle drivers of approaching cars. In this figure the curved line A^2 represents a vertical section of the zone A, and correspondingly A′, on a plane perpendicular to the elements of these zones. The curve B^2 represents a section similarly determined of the zones B and B′, while C^2 represents the same character of section of the zones C and C′. By reference to the curve A^2 and the rays which are shown as emanating from the lamp L and reflected from the curve, it will be recognized that the lower part of the curve is a parabola, arranged to reflect rays horizontally, and the upper part is elliptical arranged to reflect rays convergently downward. The curves B^2 and C^2 are similar in principle but of different focal length, by reason of the fact that their elements are at different distances from the lamp than the zone A. Figure 1 illustrates these differences; showing by the broken line f the perpendicular distance from the lamp to the nearest point of the zone A, which is the focal length of the curve A^2, the broken line f' showing the perpendicular distance from the lamp to the extension of the nearest element of the zone B, and being the focal length of this zone; while f^2 is the corresponding distance from the lamp to the prolongation of the nearest element of zone C to the lamp, and is the focal length of this zone. Of course as the zones are cylindrical, the intersections of each surface with all planes perpendicular to its elements have the same curvature.

Inasmuch as the zones, being cylindrical, have straight lines as their elements, their foci are straight lines and not points. The focal line as to any zone is the locus of the focal points of all sections of the cylindrical surface cut by planes perpendicular to its elements. In another mode of statement such focal line is parallel to the elements of the cylindrical surface and passes through the focus of the curve located by the intersection with the cylindrical surface of any plane perpendicular to its elements. The previously described location and arrangement of the different zones cause all of their focal lines to intersect at a common point, and at this point the light source is located.

A general statement of the salient characteristics of reflectors embodying the invention may be made as follows:—

Having regard to the medial plane of the reflector perpendicular to the direction of the desired spread of light, which may be called for the purposes of this statement a reference plane, the total reflecting surface is composed of a plurality of concave zones on each side of the reference plane, each of such zones having a cylindrical focalizing surface, and the several zones being of different focal lengths and being located at such distances from the reference plane and at such angles to said plane that their focal lines intersect at a common point. When the parts of the reflecting surface at opposite sides of the reference plane are symmetrical, the common point of all the focal lines is in that reference plane. This intersection point may be considered as the focus of the entire reflector. The lamp or light source is located in or so near to such focus as will cause the desired results in respect to the reflection of light. The preferred characteristic is that the different zones of the reflecting surface shall be so inclined to the reference plane and of such widths that the rays reflected from all the zones will occupy substantially the same position in space. The consequence of the foregoing facts is that all the surface elements of all of the zones are in planes perpendicular to the reference plane and parallel to one another and to the spread of light, although the positions of said elements in said planes are inclined to the reference plane and to the elements of adjacent zones. Where adjacent zones meet, lines of intersection are established in planes which may be here considered as "intersection planes". Such intersection planes are perpendicular to the plane of light spread, and in the preferred form of the invention, are likewise parallel to one another. However, minor variations in one or more of these conditions may be made within the scope of the protection which I claim herein, provided the results secured, and the means for effecting them, are substantially as set forth in this specification.

In the particular case of a reflector arranged to secure horizontal spread of light, which is the case described in detail in the foregoing specification, the surface elements of the zones are horizontal and the reference plane is vertical. The boundaries or edges of the several zones or panels thus extend and lie in planes which are transverse to the previously defined horizontal medial plane of the reflector, and intersect such horizontal plane. The scope in which I claim protection is by no means limited to this particular case since the same reflector may be mounted in various positions wherein its surface elements and "reference plane" have other relations to the horizontal and vertical. It will be apparent from the foregoing description and analysis that a reflector formed with zones or panels having the curvature and arrangement thus described conforms in general to a concave focalizing reflector, and that the outline of the reflector in horizontal midsection so conforms, in a general or approximate way, to a focalizing curve, but with such divergence from such curve as follows from making the light dispersing zones with substantially straight elements.

The reflector having the characteristics here described may readily be made from sheet metal by being formed between appropriately shaped dies, and in these drawings I have represented the reflector as being so made of such material. As thus made the outer surfaces have substantially the same form and characteristics as the reflecting surfaces, but this is not important since it is only the reflecting surfaces which must have the essential characteristics herein pointed out, and the outer surfaces may have any form. The reflector, therefore, may be made otherwise than by pressing between dies and of other material than sheet metal. It is intended to be mounted in the casing of the headlight, and, as manufactured, is provided with any means for such purpose, and means for mounting a lamp, such as are already familiar in the art.

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

1. A reflector having a general contour of a concave focalizing surface and characterized by curvature variations constituting a plurality of panels extending in a general direction intersecting the horizontal medial plane of said reflector, said panels providing a series of reflecting surfaces configurated to project from a source of light within said reflector, a beam of light of greater extent horizontally than vertically.

2. A projecting light reflector adapted to a point light source and conforming in horizontal and vertical axial section generally to a focalizing curve, said reflector being formed with a plurality of surfaces which, in vertical section, are curved similar to said focalizing curve, but in horizontal section depart from said curve sufficiently to spread the light in horizontal planes.

3. A reflector having the general contour of a concave focalizing surface, said reflector comprising a plurality of flattened panels, each of said panels being adapted to reflect from a source of light within said reflector, a beam of light of greater extent horizontally than vertically, said panels being positioned with respect to each other and to the light source so as to superimpose the beams to occupy the same position in space.

4. A projecting reflector having its reflecting surface on each side of a medial reference plane comprising a plurality of cylindrical zones, the elements of the several zones being arranged at different angles to said reference plane but all in planes perpendicular thereto.

5. A projecting reflector having a plurality of cylindrical zones of similar cross section, but of different focal lengths with non-coincident focal lines intersecting at a common focus.

6. A projecting reflector having a plurality of cylindrical zones of different focal lengths having non-coincident focal lines intersecting at a common point and all the surface elements of said zones being in parallel planes.

7. A projecting reflector having a reflecting surface comprising distinct cylindrical zones in which the surface elements are all horizontal but inclined to the elements of adjacent zones, different ones of such zones being generated with respect to curves having a common focus and respectively different focal lengths.

8. A projecting reflector having a reflecting surface comprising distinct cylindrical zones in which the surface elements are all horizontal, different ones of such zones being generated with respect to parabolic curves having a common focus but respectively different focal lengths and non-coincident intersecting focal lines.

9. A projecting reflector having a reflecting surface comprising distinct cylindrical zones in which the surface elements are all horizontal, different ones of such zones being generated with respect to curves which above the horizontal axial plane of the reflector are elliptic and below said plane are parabolic; said curves having non-coincident focal lines intersecting at a common focus and respectively different focal lengths.

10. The combination of a projecting reflector having a focal point and a light source located approximately at such focal

point; the reflecting surface of said reflector comprising distinct cylindrical zones all following curves which have a common focus in said focal point, certain of said zones having different focal lengths and being arranged with respect to said focal point to reflect the beams emanating from the light source over substantially the same predetermined area.

11. In a projecting lamp the combination of a reflector having a plurality of cylindrical zones, the elements of which are all in parallel planes, following similar curves which have non-coincidental intersecting focal lines and respectively different focal lengths as to certain zones, and a point light source located approximately at the intersection of said focal lines.

In testimony whereof I have affixed my signature.

SUMNER E. BROWN.