Oct. 23, 1923. 1,471,767

W. H. WOOD

HEADLIGHT FOR VEHICLES

Filed Oct. 6, 1920 2 Sheets-Sheet 1

Fig. 1

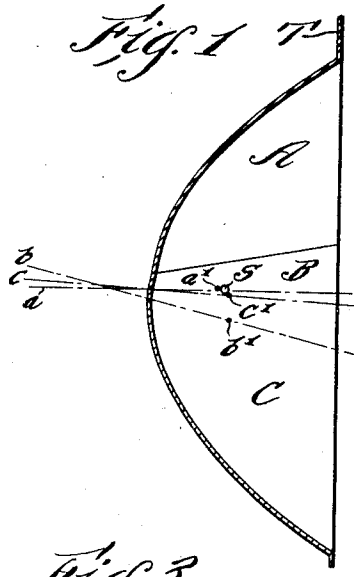


Fig. 2

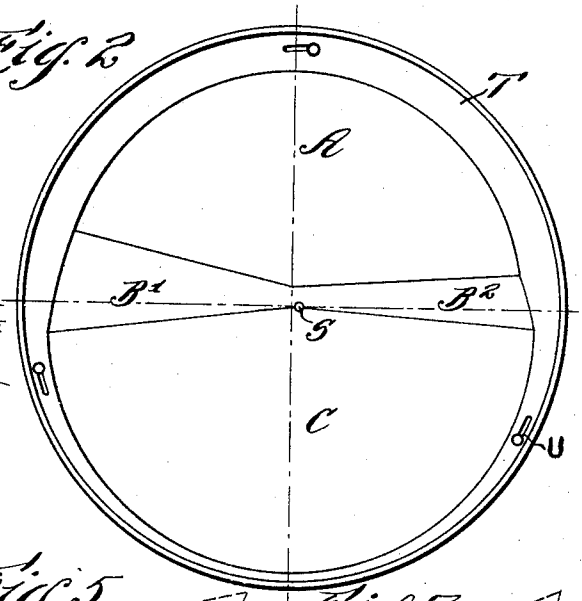


Fig. 3

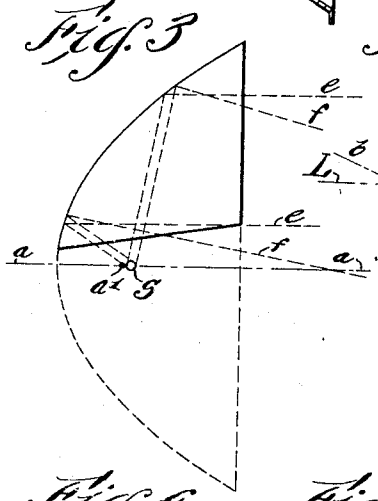


Fig. 5

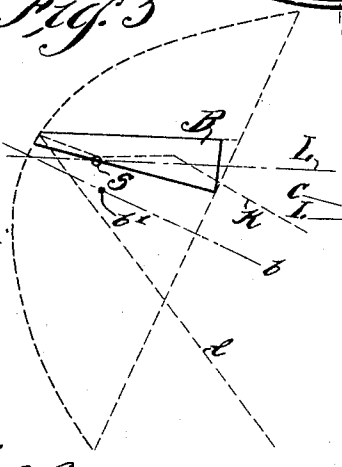


Fig. 7

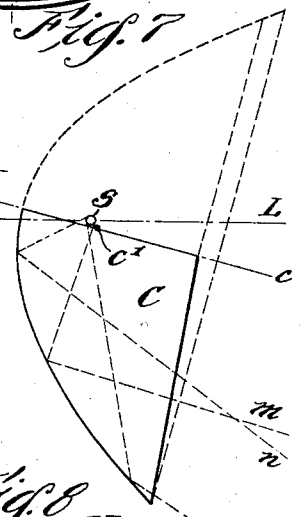


Fig. 4

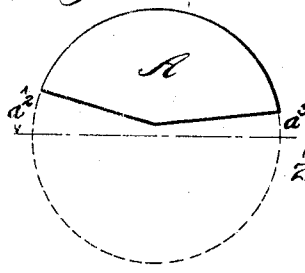


Fig. 6

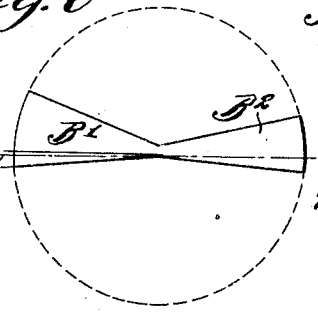
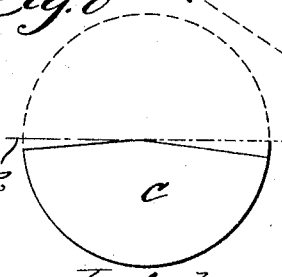


Fig. 8



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Fig. 9

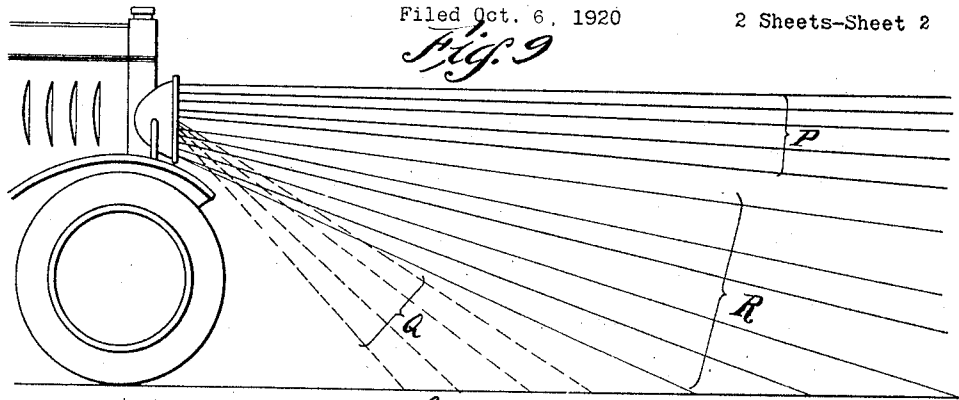


Fig. 10

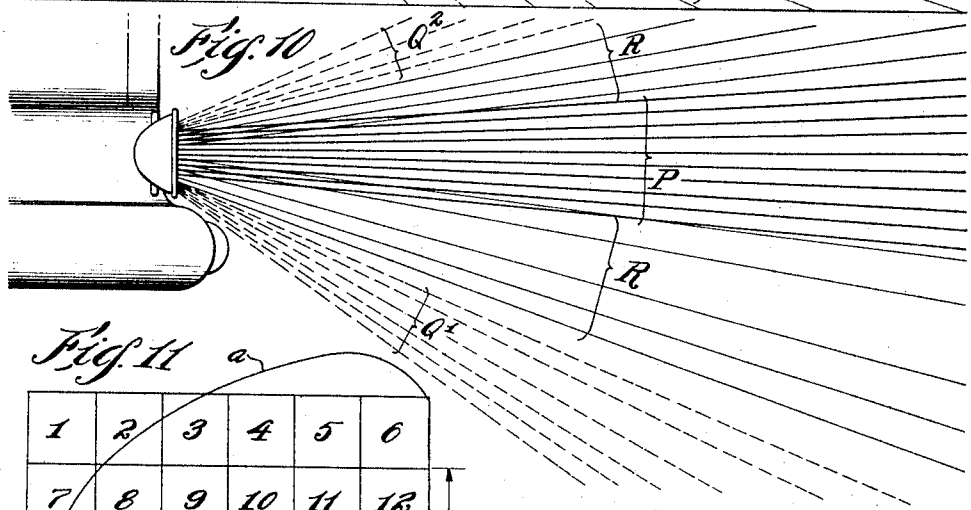


Fig. 11

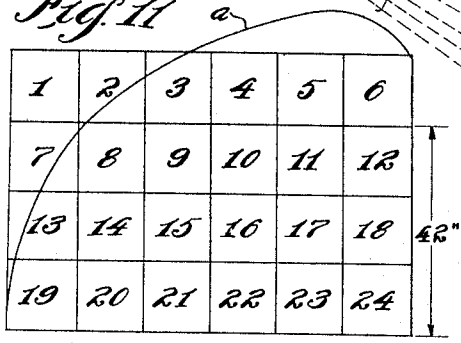


Fig. 14

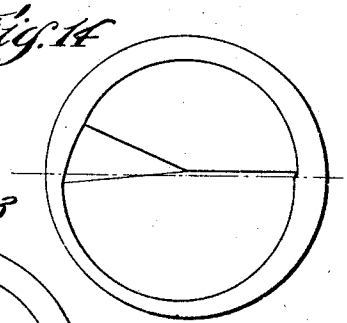


Fig. 12

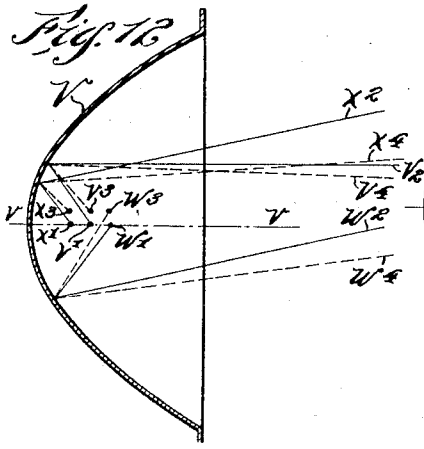
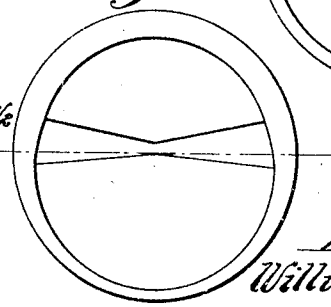


Fig. 13



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Attys.

Patented Oct. 23, 1923. 1,471,767

UNITED STATES PATENT OFFICE.

WILLIAM H. WOOD, OF CLEVELAND, OHIO.

HEADLIGHT FOR VEHICLES.

Application filed October 6, 1920. Serial No. 415,021.

To all whom it may concern:

Be it known that I, WILLIAM H. WOOD, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Headlights for Vehicles, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention relates to headlights, especially those employed on motor vehicles. Safety and convenience of vehicle operation in the dark requires the illumination of the ground for a considerable distance in front of the machine and to some extent at either side thereof, yet also requires keeping the rays of light sufficiently low towards the side exposed to oppositely moving vehicles to avoid blinding the eyes of the drivers thereof. Furthermore the intensity of the illumination throughout the illuminated area should vary from point to point according to the obvious requirements of operation, this comprising a powerful distance beam for fast driving in a straight path combined with a softer light closer to the wheels and a laterally directed curb light sufficient to enable the avoidance of obstructions and the recognition of persons at the curb-side of the vehicle. Not only are these conditions desirable to the driver but many of them are required by law in the different States, which laws prescribe the intensity limits in different parts of the field. While these laws vary greatly their common purport is that above indicated and all can be complied with by a device having the above characteristics.

Lenses have heretofore been developed possessing most of the foregoing requirements but these are necessarily expensive to make and of a fragile nature, while their employment does not dispense with the necessity of using a reflector nor of focusing the light source carefully with reference thereto. The objects of my invention are the provision of a simple, one-piece, reflector which shall satisfy all the foregoing needs and at the same time dispense with the necessity of a special lens; the provision of a reflector of the desired light-distributive character which shall be no more expensive to manufacture than the plain parabolic reflector, which shall possess the qualities mentioned without serious irregularities of shape or marked divergencies in surface, which can be easily manufactured from sheet metal by commercial processes and conveniently polished and finished, which can be focused with ease and within a comparatively wide permissive range; and which can be employed in present headlights without any other change whatsoever; while further objects and advantages of my invention will become apparent as the description proceeds. The present invention constitutes an improvement upon the device disclosed and claimed in my former patent granted July 31, 1917, No. 1,235,275 and it is distinguished therefrom chiefly in the definition, location and relation of the various reflector segments and the relations of the light source thereto, being a continuation in part of my application No. 324,338, filed September 18, 1919. The objects of the present invention are therefore identical with the general objects defined in said patent, the same being secured in a larger measure and to a more accurate degree than heretofore.

In the drawings accompanying and forming a part of this application I have shown certain illustrative embodiments of my invention together with certain diagrammatic views illustrating the scientific theory of the same and setting forth graphically the purposes of the different parts of my improved reflector. In these drawings Fig. 1 is a vertical section through a preferred form of reflector embodying my improvements; Fig. 2 is a front view of the same; Figs. 3 and 4 are diagrammatic views illustrating the shape, position and function of one element of said reflector; Figs. 5, 6 and 7, 8 are similar views illustrating, but in exaggerated degree, the shape, position and function of other elements of said reflector; Fig. 9 is a side elevation of an automobile headlight provided with my improved reflector and illustrating the distribution of the rays; Fig. 10 is a top plan view of the same showing the general outline of the light pattern; Fig. 11 is a graphic light-chart; Fig. 12 is a horizontal sectional view of my improved reflector illustrating the result of displacing the light source laterally; and Figs. 13 and 14 are face views of modified reflectors embodying my improvements.

My improved reflector comprises portions of a plurality of paraboloid surfaces arranged in definite relations towards each

other and toward the light source. These portions are represented at A, B and C, their axes at *a*—*a*, *b*—*b* and *c*—*c*, respectively, their focal points being indicated at *a'*, *b'* and *c'*, respectively. The lamp axis coincides with the axis *a*—*a* and is represented by L—L, in views where *a*—*a* does not occur, and S representes the light source which is located upon the horizontal plane containing this axis, but preferably slightly to one side thereof for a reason which will later appear.

The section A subtends less than 180° of arc as illustrated in Figs. 2 and 4 and terminates at a point short of its vertex as shown in Figs. 3 and 4, its axis *a*—*a* substantially coinciding with the lamp axis as shown in Fig. 1. The light source, which is ordinarily an electric lamp filament of the type concentrated into a small space, is located in the plane of this axis close to, but in front of the focal point *a'*. As a consequence of this, all rays of light originating at that point of the source nearest to the focal point will be thrown forwardly in a direction substantially parallel to the plane of the lamp axis as indicated at *e*—*e* in Fig. 3, while those originating at the extreme top and extreme forward parts of said source will be thrown downwardly across the axis as shown at *f*—*f*. This portion of the reflector gives rise to the rays indicated at P in Figs. 9 and 10 which serve for the distant and concentrated lighting and correspond generally to the square 9, 10, 15, 16 of Fig. 11.

In order to prevent any of the convergent rays *f*—*f* from striking across the lamp axis toward the opposite side of the road with such a slant as to cast a glare into the eyes of drivers and draft animals moving in the opposite direction, the margin of the portion A at the side nearest the curb is terminated at a sufficient height above the plane of the lamp axis to prevent any rays, even from the most extreme portions of the source, from being thrown across the road; but inasmuch as the existence of a certain amount of illumination on the curb side is not only conducive to driving-comfort but is required by the laws in some localities, the opposite margin of the portion A is conveniently continued to a sufficiently low point to yield the amount of illumination desired. This point may even be as low as the plane of the lamp axis, thus affording an asymmetrical arrangement as indicated at a^2 and a^3 in Fig. 4, the wider gap being on the curb side.

The section B is a comparatively narrow zone taken from a portion lying near the vertex of a larger paraboloid surface and constitutes the side wings described and claimed in my Patent No. 1,325,275. Its axis *b*—*b* is inclined downwardly at a considerable angle, such axis, however, lying in the same vertical plane as the lamp axis. This inclination (which is indicated in exaggerated degree in Fig. 1 and in still more exaggerated degree in Fig. 5) causes the entire source S to lie considerably above the same; the size of this paraboloid is so chosen that when the upper margin of the zone in question is matched with the lower margin of the section A, the focal point *b'* also falls ahead of the light source; all of these conditions (namely, the inclination of the axis, the vertical displacement of the source, and the location of the source behind the focal point) combine to produce a downward divergence of all light rays which fall thereon as shown at K and L in Fig. 5, thus giving rise to the beams indicated in broken lines at Q in Figs. 9 and 10. This zone is not made of equal widths upon its two sides, but the side nearest to the curb is made wider as indicated at B' and the opposite side narrower as shown at B^2, thus compensating for the inquality of the section A. In fact, within the practical and legal requirements of illumination the narrow side of this zone can be omitted entirely as shown in Fig. 14, but this entails practical difficulties in construction which will be referred to later.

The section C is here shown as subtending approximately 180° of arc and as terminating substantially at its vertex as shown in Figs. 7 and 8, its axis *c*—*c* being inclined downwardly relatively to the lamp axis but by an angle less than that of the axis *b*—*b*. Its size is such that its focal point *c'* lies in front of (or at least not behind) the most advanced portion of the light source, the latter, owing to the inclination of the axis *c*—*c*, also lying above such focal point. As a result of this relation of light source and focal point, all the rays falling upon this portion of the surface C are diverged as shown by the lines *m*, *n* and *o* of Fig. 7, and hence give rise to the beams indicated at R in Figs. 9 and 10. The inclination of the portion C prevents any of the rays therefrom being thrown sufficiently high to dazzle the eyes of man or draft animals moving in the opposite direction. It is generally made of a larger paraboloid than the section A and its shape at the front, owing to its inclination, is somewhat elliptical.

The point of intersection of the various axes is unimportant. They may intersect at the same point or at different points. Likewise it is generally unimportant as regards my invention exactly how near to the vertex of the different paraboloids any of these sections extend, provided only that the herein-described relationship between axes and focal points are preserved. This range of choice enables a choice of sections

whose margins shall coincide at every point without the formation of hollows or ridges which would weaken the device, cause shearing in the dies, or impede the polishing operation. Within the same limits the sizes of the paraboloids are unimportant, although it is this variation in sizes which largely produces the desired relation of focal points while maintaining the vertices approximately coincident. Within these limits a slight variation in relative sizes assists materially in matching the margins of adjacent portions. Within the same limits the width of the portion B^2 is susceptible of wide variations; the top line of the part B′ is fixed by the illuminating conditions heretofore described, but the bottom line thereof is determined only by the requirements of meeting smoothly the margin of the lower section. Likewise the top line of the part B^2 is fixed by the requirements of lateral illumination on the curb side of the machine while the bottom edge is variable to enable a smooth joint with the lower section. Excepting for this last consideration it would be possible to omit the wing B^2 entirely as heretofore suggested; but practically the only way of matching two unequal paraboloid sections together is by the interposition of a third paraboloid section, wherefore I prefer to retain some vestige of this wing. It will be understood that the wings B′ and B^2 need not be segments of the same paraboloid surface but may be of different sizes or taken at different angles.

As an example of a successful reflector embodying my improvements I will instance the following. Upper section 7½ in. diameter, 3 in. deep, 1⅛ in. focal distance, margin at heel 1¼ in. from axial plane and at each side in front ¾ in. from axial plane; lower section 8 in. diameter, $3\frac{1}{16}$ in. deep, depressed ¼ in. at mouth focal distance 1¼ inch; intermediate section has a focal distance of $1\frac{9}{32}$ inches and is leaned downwardly ¾ inch at the face, thus producing two wings each 1 in. wide at the mouth and ¼ inch wide at the heel. To render the wings unequal the top section is shortened ½ inch at the curb side and the zone section rotated correspondingly so as to justify the line. The lamp axis lies within the limits of this zone.

Further to control the rays of light and to produce the asymmetrical field of illumination hereinbefore mentioned with the maximum at the curb side, I preferably displace the light source slightly to one side of the vertical plane. The result of such displacement is to move the light beam transversely of the lamp axis by an amount varying with the distance of the source from the transverse plane which includes the focal point. The greater the initial deviation of the beam, the greater will be the effect of such lateral displacement; hence the effect on the rays thrown from the section A is comparatively small, since the light source lies especially close to the focal point of this section; in other words the distance beam is not much affected, while the effect upon the light reflected by the side wings is particularly great. Therefore by shifting this light source slightly towards the left the direction of the main beam P is very slightly changed, the direction of the secondary beam R is somewhat more changed, while the direction of the portions Q—Q are so deflected as will shift the entire light field towards the curb and away from the center of the road as shown in Fig. 10. It will be understood that both headlights are preferably made in the same manner and asymmetric in the same direction, their effect being additive so far as they overlap each other, and the illumination of the left hand light extending not beyond the center of the road. However this displacement of the field by displacement of the source laterally is not confined to a reflector having such unequal side wings but is equally important with one having equal side wings as shown in Fig. 13 and used in connection with a plain paraboloid reflector will greatly reduce its objectionable qualities.

The result of such lateral displacement of the light source is shown in Fig. 12, wherein V represents a horizontal section of a paraboloid reflector, V—V represents its axis, and V′ its focal point. Light rays originating at V′ are always reflected parallel to the axis as shown at V^2 and a lateral shift to the point V^3 only moves the reflected beam as shown in the dotted line V^4. Light rays originating at W′, on the axis forward of the focal point are converged across the axis as shown at W^2 and a lateral shift to the point W^3 moves the reflected beam in the opposite direction and through a much greater angle as shown by the dotted line W^4. Light rays originated at X′, on the axis behind the focal point are diverged as shown at X^2, and a lateral shift to the point X^3 moves the reflected beam through a similarly great angle in the opposite direction as shown by the line X^4. It will be understood that operative headlights always generate both concentrated and diffused beams, the former arising from those regions of the source which lie nearest the focal point and the rest arising from those regions of the source which are further away therefrom.

By reason of the laterally inclined or axially rotated position of the segment A, and of the different heights of the intermediate segment or segments upon the two sides of the reflector, and the lateral displacement of the light source S, the light

pattern becomes asymmetric as indicated approximately by the line *a* in Fig. 11, all glaring rays being removed from the road side of the vehicle, and with the deflection of sufficient light towards the curb to avoid danger of striking obstacles or pedestrians on that side of the street. I have refrained from describing this as the right hand side of the vehicle because of the well known fact that in some countries the vehicles pass to the left of each other, and the left hand side becomes the curb side. Likewise I do not confine myself to a construction wherein all three of these deflecting features are used except as I have specifically claimed the same as co-existing in a single structure, since any one of these features will sometimes be found sufficient for some purposes.

While it will be understood that it is entirely possible to construct such a reflector as herein described by actually cutting out sections or slices of three separate paraboloids and physically uniting them at their edges, my improved reflector is preferably made from a single sheet of metal by drawing it in dies of the requisite form to afford the necessary shapes to the different portions; and in that event a portion of the original plate is left as shown at T to constitute a stiffening flange and attaching rim which can be provided with bolt-receiving slots U or other securing devices if desired. The exterior of this rim is preferably made circular, its width being sufficiently great to compensate for the non-circular character of the concave portions of the reflector as shown in Fig. 2. Experience shows that a reflector of this nature can be drawn by a single operation and polished with the same speed and by the same apparatus as is used in connection with the plain paraboloid reflectors.

The chief advantages of this reflector are that it dispenses with the necessity for any special type of lens and enables a mere pane of glass to be employed; owing to its peculiar form, the limits of tolerance as regards the adjustment of the light source are very wide, thus enabling adjustment to be made by unskilled persons and still securing a character and distribution of light which will enable comfortable driving and comply with legal requirements. The chief advantages of this reflector over that shown in my former patent are that the side wings possess a definite shape which can be made about an axis of revolution and that the light field possesses the asymmetrical shape described.

It will be understood that I do not restrict myself to the exact details herein described except as recited in my claims.

Having thus described my invention, what I claim is:

1. A reflector body having a pair of upper and lower surfaces of revolution facing each other on opposite sides of the lamp axis, the lateral margins of said surfaces being spaced apart by unequal distances and connected by interposed surfaces of revolution of smaller curvature.

2. A reflector body having a concave portion substantially located upon one side of a longitudinal axis and also having at each side of said axis a wing portion subtending the axial region, the upper parts of said wing portions being inclined inwardly toward each other and one of said wing portions being wider than the other.

3. A one piece metal reflector for automobile headlights comprising a pair of opposed segments of unequal sized paraboloids located upon opposite sides of the reflector axis and having at their open ends an integral circular flange which is perpendicular to said axis, the axis of the smaller paraboloid segment coinciding with said reflector axis and that of the larger paraboloid diverging from said axis, the smaller paraboloid segment subtending less than 180° and having its vertex located ahead of the vertex of the larger paraboloid so as to bring the focal points of the two segments more closely together, and an intermediate inwardly leaning section connecting the margins of said segments.

4. A lamp reflector made of a single piece of sheet metal having its upper and lower portions formed as separate surfaces of revolution arranged substantially about a common horizontal axis, and having its intermediate portions formed separately from both surfaces and inclined toward each other, such intermediate portions being of unequal angular extent upon the opposite sides of the reflector.

5. A reflector having a pair of opposed semi-parabolic surfaces, one being of larger diameter than the other and the two surfaces being slightly offset at their vertices, the adjacent marginal edges of such parabolic sections being joined by a reflecting surface which is separate from each of them and is inclined at every point toward the smaller parabolic surface and is narrower on one side of the reflector than upon the other.

6. In a headlight, the combination with a light source of a one piece, sheet metal, reflector having upper and lower opposed paraboloid segments and interposed lateral segments merging with the adjacent margins thereof, the upper segment converges the light falling thereon, the lower segment diverges the rays falling thereon, and the lateral segments are wider at the mouth of the reflector than at the apex and are of unequal angular extent.

7. A headlight for vehicles comprising a reflector made in one piece having upper and

lower opposed paraboloid surfaces whose margins are spaced apart, such upper surface subtending less than 180° and the lateral margin of said upper surface which is upon the curb side of the vehicle being located at a higher level than the other margin thereof, and a paraboloid surface of smaller curvature connecting the adjacent margins of said upper and lower segments, and having its axis located beneath the lamp axis.

8. A headlight for vehicles comprising in combination a reflector having its upper and lower sides conforming to segments of different paraboloids facing each other upon opposite sides of a common axis, and a segment of a third paraboloid interposed between and connecting the first two segments, at one side of said reflector, said last paraboloid having its axis located below said common axis, and a light source located on substantially the same plane with said common axis but upon the side thereof which is opposite to the curb side of the automobile.

9. A headlight for vehicles comprising a reflector having a pair of opposed semi-parabolic reflecting surfaces arranged in flaring relation to each other, the axis of the upper surface coinciding substantially with the lamp axis and the adjacent marginal portions of said parabolic surfaces being spaced apart unequal distances, said first surfaces being connected upon that side which shows the widest separation by a third paraboloid segment whose axis is disposed below the lamp axis, in combination with a light source located substantially upon the horizontal plane of the lamp axis and at the side of that axis upon which the first mentioned parabolic surfaces approach most closely together.

10. In an automobile headlight, a one piece sheet metal reflector comprising segments of three paraboloid surfaces, one of said segments subtending less than 180° and having its axis substantially horizontal, another located opposite thereto and having its axis inclined toward the roadway, and the third located intermediate the first two and consisting of an eccentric paraboloid zone whose axis is inclined toward the roadway.

11. In an automobile headlight, a one piece, sheet metal reflector comprising two semi-paraboloid portions located opposite each other, the axis of one of said portions substantially coinciding with the lamp axis, and a paraboloid zone interposed between said first two portions and having its axis oblique to the lamp axis, said lamp axis falling within the region defined by said zone, and the margins of said third zone terminating at unequal distances above the horizontal.

12. In an automobile headlight, a one piece, sheet metal reflector comprising segments of three paraboloid surfaces, one of which subtends less than 180° and has its axis substantially coincident with the lamp axis, another of which consists of a paraboloid zone whose axis lies below the lamp axis, the third being substantially a semi-paraboloid whose focal point lies below and outside that of the first named portion, in combination with a light source located between said focal points and to one side of the lamp axis.

13. In an automobile headlight, a one piece, sheet metal reflector comprising segments of three paraboloid surfaces, the uppermost being substantially a semi-paraboloid which subtends less than 180°, the lowermost being a semi-paraboloid of larger size with its axis inclined downwardly and forwardly, and the intermediate segment being a zone of a paraboloid of still larger size, having its axis below the axes of the first two segments and having the height of its upper margins unequal at the two sides of the reflector.

14. In an automobile headlight, a reflector comprising three paraboloid segments, the uppermost being substantially a semi-paraboloid which subtends less than 180°, the lowermost being a semi-paraboloid of larger size with its axis inclined downwardly and forwardly, and the intermediate segment being the eccentric zone of a paraboloid whose axis is still further inclined downwardly and forwardly, the margins of the adjacent segments merging smoothly together and forming a continuous reflector free from abrupt corners.

15. A reflector comprising two opposed semi-paraboloid portions arranged with their axes at an oblique angle, and an intermediate paraboloid portion whose edges meet the edges of the first portions at all points, and whose upper margins lie at different heights upon opposite sides of the reflector.

16. A reflector comprising two opposed semi-paraboloid segments arranged with their axes at an oblique angle and an intermediate paraboloid zone, such zone lying entirely to one side of the vertex of the paraboloid from which it is taken and the margins of said zone making a flush joint with the margins of the adjacent paraboloid segments.

17. A one piece sheet metal reflector comprising segments of two opposed semi-paraboloid surfaces arranged opposite each other with their axes diverging, and an intermediate paraboloid zone whose margins coincide with the margins of both of the first segments and whose axis crosses the axis of one of the first segments.

18. A reflector comprising two opposed semi-paraboloid segments of unequal size arranged with their axes at an oblique angle and an intermediate segment consisting of a paraboloid zone, such zone being taken en-

tirely to one side of the vertex of its generating paraboloid and said last named axis being oblique to the axes of both the first named segments.

19. In a lamp, a one piece, sheet metal reflector comprising segments of two opposed semi-paraboloid surfaces of unequal size arranged on opposite sides of the lamp axis with their axes at an oblique angle to each other, one of said segments subtending less than 180° and having its margins spaced at unequal distances from the horizontal plane, and a pair of intermediate paraboloid segments whose margins coincide with the adjacent margins of said first segments and whose normals everywhere lie beneath said lamp axis, the lamp axis lying within the limits of the zone defined by said last named segment.

In testimony whereof, I hereunto affix my signature.

WILLIAM H. WOOD.