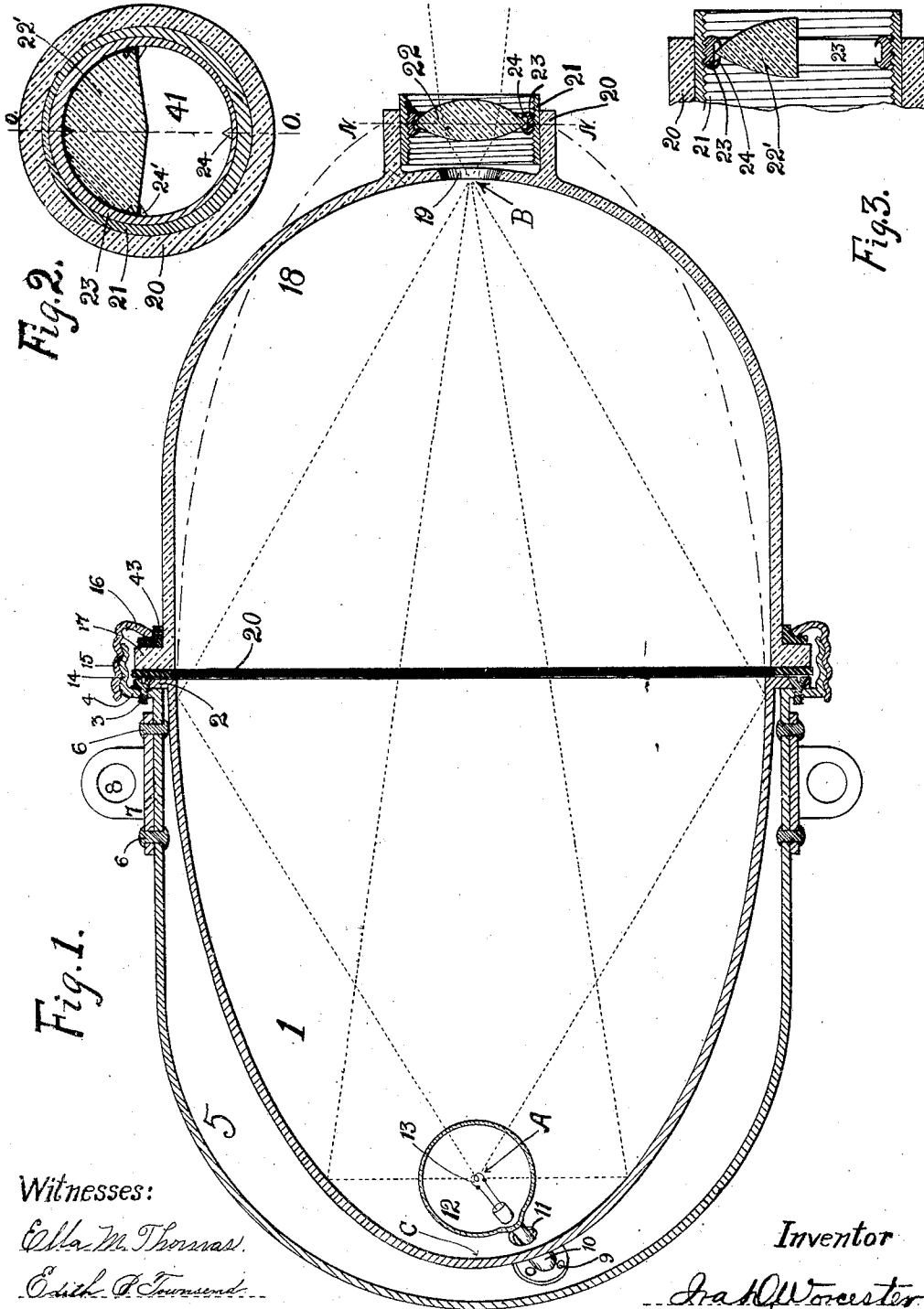


I. D. WORCESTER.
 LIGHT PROJECTING LANTERN.
 APPLICATION FILED SEPT. 26, 1914.

1,349,706.

Patented Aug. 17, 1920.



Witnesses:

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Specification of Letters Patent.

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Application filed September 26, 1914. Serial No. 863,701.

To all whom it may concern:

Be it known that I, IRA D. WORCESTER, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Light-Projecting Lantern and Process of Rendering the Projected Light Non-Blinding, of which the following is a specification.

My invention relates to improvements in lanterns, and is applicable particularly to headlights for automobiles.

The invention is illustrated in the accompanying drawings: Figure 1 is a view in section on horizontal plane through the middle of an automobile headlight embodying my invention; Fig. 2 is a view in vertical section on the plane indicated by the line N—N, Fig. 1; and Fig. 3 is a fragmentary view in vertical section, on the plane indicated by the line O—O, Fig. 2.

The headlight shown in the drawings includes a source of illumination and means for gathering the emanated rays and projecting them to and beyond a focus in a divergent pencil of light; specifically, the drawings show an incandescent bulb 12 with a filament 13, arranged at the proximate focus A of an ellipsoidal mirror 1.

These parts are assembled and mounted in suitable manner. As here shown, the mirror is inclosed in and supported by a shell or casing 5. This casing will ordinarily be formed of metal. Secured to opposite sides of said casing by suitable means such as rivets 6 are lugs 7 having vertical holes 8, suitable for engaging a forked support borne by a vehicle body. The lamp 12 is mounted in the casing 5, its socket 10 being secured to the casing by suitable means such as screws 9. The lamp socket 10 is placed adjacent the vertex C of the mirror 1 and a hole 11 is formed in the mirror, and through this hole the neck of the lamp extends to enter socket 10. These parts are so arranged that the light-giving filament shall, when the lamp is in place, be substantially at, and by preference as nearly as may be at the proximate focus of the mirror. Preferably the socket 10 will be arranged at one side of the axis of the mirror to the end that the hole 11 shall not extend through the mirror at its vertex. This hole,

wherever it may be located, will constitute an interruption of the reflecting surface of the mirror, and will therefore cause the absorption of certain rays which otherwise would be reflected and being reflected form part of the projected beam of light. It is better that these rays should be cut out, not at the very axis of the mirror, but rather at one side from the axis.

In Fig. 1 I have diagrammatically indicated the path of light emanating from lamp 12 and reflected by mirror 1. It will be understood that, if the mirror were a perfect reflector and exact in its shaping and if the light emanated from a mathematical point precisely at the proximate focus A of the mirror, all of the reflected light would converge precisely at the conjugate remote focus B of the mirror. In point of fact, such an ideal condition does not obtain, but an appreciable quantity of the emanated light is irregularly reflected and is projected in paths which deviate more or less widely from the remote focus. It is part of my invention to eliminate a certain bad effect which these irregularly reflected rays if left uncontrolled produce, and to employ them rather for a good and serviceable end.

It is these irregularly reflected rays, these rays which digress widely from the ideal paths convergent at the remote focus B, which, when they reach the eye of a person facing the lantern, give the effect of an extended source of illumination and cause him to be blinded. If only the regularly reflected rays reached his eye, the blinding or dazzling effect upon him would be far less. It is a feature of the lantern of my invention that, while the regularly reflected rays are properly directed and controlled, the errant rays are intercepted and the blinding which they otherwise would produce is prevented. The means which I employ to effect this end consist in a screen extending across the field of emanated light and so constructed as to serve as a filter, affording free passage to the regularly directed rays and intercepting the irregularly directed ones. Such light-filtering devices are known to the art and do not require extended discussion. I shall confine detailed description to the screen in the particular

form shown in the drawings. This screen 18, extending as it does across the field of light emanating from the ellipsoidal mirror 1, crosses the remote focus B of the 5 mirror. Since the regularly reflected rays are gathered to this focus, it is sufficient that the screen be transparent adjacent this focus and non-transparent elsewhere, in order to serve as a filter to effect the end described. Transparency at this point may be 10 had by forming an opening 19 in the screen.

My invention contemplates more in this regard than the mere cutting-off of the irregularly proceeding rays. The rays which 15 are regularly reflected and those which deviate but little from the true path proceed freely through and beyond the screen and afford a field of major illumination; the errant rays (together with those rays which proceed directly and without reflection from the source of illumination and strike the non-transparent portion of the screen) are preferably not absorbed and lost; the non-transparent 25 portion of the screen is preferably translucent; and, in consequence, the light subtended by the screen is broken up and diffused. The field of major illumination of the lantern is then surrounded by a field of minor illumination, a field of diffused light. The blinding effect of errant rays, noted above, is eliminated; lateral illumination is not lost; a field of soft and diffused light surrounds the field of intense illumination. This surrounding field of soft light is 35 useful, not merely for lateral illumination for the benefit of occupants of the vehicle, but to relieve strain upon the eyes of one who faces the vehicle. In his eyes, the intense central illumination is set in a background so to say of softer light, and the strain upon his eyes is less than if there were no such background for the main body of light.

Turning attention now to the regularly reflected rays and the field of major illumination which they afford, it will be understood that the light is brought to a focus at or near the remote focus B of the mirror—precision in this matter being dependent on 50 precision of the placing of lamp 12 at the conjugate proximate focus A of the mirror. Beyond the remote focus B the normal path of the emanated light is in a divergent pencil. For automobile service the forwardly 55 downwardly and medially directed rays of this pencil of light are serviceable to illumine the roadway upon which the vehicle is advancing, but the upwardly and outwardly directed rays are more than sufficient for 60 lateral illumination and, besides, they are objectionable in that they are projected with unpleasant intensity in the eyes of those who face the approaching vehicle,—whether drivers of oppositely traveling vehicles, pedestrians, or others.

My invention provides for the deflection of rays not useful to illumine the roadway and objectionable in the eyes of other wayfarers.

In suitable proximity to the remote focus 70 B of the mirror of my lantern I arrange a body which, while not interfering with illumination of the roadway, shall change the direction of rays not useful for illumination and objectionable for the reasons stated, 75 causing them to diverge less widely, or even to proceed in parallel paths or to converge. The shape and extent of this body, beyond such parts of it as subtend the rays which have been described to be objectionable, do 80 not now concern me; nor does its effect or lack of effect upon the road-lighting rays now concern me; I am here concerned only with the rays which have been described to be objectionable. These are subtended and 85 deflected.

For the ends with which I am concerned this body includes or consists of an incomplete lens placed in the axis of the mirror, adjacent to its remote focus, and subtending 90 and deflecting the objectionable rays (or, at least, the major portion of them), but not interfering substantially with the road-lighting rays (or, at least, the major portion of them). A suitable lens for the purpose described is an ordinary spherical lens; if arranged on the near side of the focus B it will be a concave lens, but if arranged on the far side (as shown in the drawings) it will be a 95 convex lens. The lens may be rendered incomplete, for the purposes described, in any suitable way. The drawings show an ordinary double convex lens arranged beyond focus B and cut entirely away from the path of the road-lighting rays (or the greater 105 part of them). If the lens were arranged on the near side of the focus it would be the upper portion which would be so cut away; but, being arranged on the far side of the focus, it is the lower portion which is cut 110 away. The lines of cutting are preferably so disposed as to avoid the presence of dark bands in the field of illumination; and, in the embodiment illustrated, the cutting is on radial lines, and the incomplete lens sector-shaped. It will be understood that, in the case of a condensing lens arranged beyond the remote focus, if the cut were segment-shaped rather than sector-shaped, and if the segment cut away were less than a semi-circle, there would be, in the projected field of light, a dark band, and the position of the dark band would be determined by and would correspond to the position of the cut; but if the cut-away segment were a semi-circle, or a segment greater than a semi-circle, there would be no dark band. And accordingly I claim in certain of the ensuing claims, in combination with other lantern parts an incomplete lens transmitting a body 130

of light continuous with the body which passes unsubtended, and in certain other claims a condensing lens cut away to its center point, and I mean to include in such definition a lens of the nature indicated which is cut away to that extent at least. It may be cut away even further.

Fig. 1 of the drawings is a view in horizontal section and the plane of section passes through the middle of the lens; and, since in this figure the lens 22 is shown uninterrupted, it will be understood that the lens may be and in this case is a sector of greater extent than a semi-circle. Figs. 2 and 3 however clearly illustrate the sector-shaped lens 22' of less extent, in this case, than a semi-circle—the complementary sector 41 being cut away. Manifestly this incomplete sector-shaped lens may be exactly semi-circular or may be sector-shaped and of greater or less extent than a semi-circle, as may be desired. It is evident that the effect of this lens is to change the direction of the rays of light which it subtends and to diminish their divergence. And it will be understood that the degree of curvature of the lens and its position relative to the focal point B of the mirror will determine the magnitude of the deflection of the intercepted rays. As intimated above, the effect may be to diminish their divergence merely, or to cause them to proceed in parallel paths, or even to converge. The advantages gained by employing this incomplete lens are or may be two-fold: Light is deflected, to the benefit of persons facing the lantern, and also illumination of the roadway is increased.

The drawings show the sector-shaped space 41, from which the lens has been cut away, to be unoccupied. As I have said, my present invention has to do with the rays subtended by the lens for the purposes described and does not have to do with the road-lighting rays, except that it leaves them to serve their intended purpose. Accordingly, I specify nothing with respect to this space 41, but require only a body which shall subtend and deflect the useless and objectionable rays of this pencil of light, regardless of whether the road-lighting rays are subtended or not and regardless of whether being subtended they are otherwise deflected or not.

The lens 22 may be carried by the screen 18 which incloses the mirror and forms the front of the lamp. This screen is preferably dome-shaped and outwardly convex, for reasons presently to be stated. A merely exemplary mode of assembling mirror 1 and screen 18 and of mounting them in casing 5 is shown in the drawings. The rim of the mirror 1 and the rim of the casing 5 are formed with flanges 2 and 4; these flanges meet when the parts are assembled and se-

curing means such as screws 3 pass through these flanges. The flange 4 of the casing 5 is provided with a threaded extension 14; the margin of screen 18 is provided with a flange 17 which, when the parts are assembled, abuts upon flange 2 of the mirror, a packing-ring 25 being interposed; and the screen is secured by a collar 15 whose inward projecting flange 16 takes over flange 17 and whose threaded body 15 engages the threaded extension 14 of casing 5. An L-shaped packing-ring 43 may be interposed between flange 16 of collar 15 and the reëntrant angle formed externally between screen 18 and its extended flange 17.

The screen 18 receives on its inner face light which emanates directly from the source of illumination and also rays of irregularly reflected light; for, as already explained, practical conditions are such that some portion of the light which falls upon the mirror will on reflection traverse paths which deviate from the remote focus. The blinding effect which these rays would have upon the eye if allowed to proceed unimpeded is a thing to be avoided. This screen 18 intercepts their path and interferes with their free progress. The screen is non-transparent and might, of course, be opaque in whole or in part, and if it were wholly opaque these errant rays would be cut off and their objectionable effect thus prevented. I prefer, however, to turn them and with them the unreflected directly proceeding rays to good account. To this end I make the screen 18 translucent. Of course I do not interfere with the free passage of the regularly reflected rays and of the rays which proceed without reflection directly from the source of illumination in paths lying in and near the axis of the mirror. Accordingly, the screen 18, at and near the axis of the mirror, at the part marked 19, is transparent, and transparency at this point may manifestly be easily afforded merely by forming an opening in the screen.

Screen 18, throughout all its extent excepting only the transparent portion 19, is as has been said preferably translucent. Of course any part of it may for other reasons, if desired, be made opaque. Any preferred translucent material may be employed; I prefer glass—either opal, frosted, or ground glass. The translucent screen breaks up the light, direct radiation is destroyed, and the light which passes is diffused. This diffused light forms an area of minor illumination surrounding the area of intense illumination afforded by the light passing through the part of the screen marked 19. The benefits and advantages of this construction have already been described.

The screen 18 is preferably dome-shaped, as shown, and the proportions such that when it is assembled in the lantern the area

19 extends adjacent the remote focus B of the mirror. As shown in Fig. 1, the focus B lies precisely in that area. Advantages gained by making the screen dome-shaped are, that, when combined with a mirror which is approximately half an ellipsoid (as shown in the drawings), it extends from the rim of the mirror, closing up the open front of the mirror, and extends to the remote focus of the mirror, where it affords support for the lens 22; it is illuminated, affords lateral illumination for the benefit of occupants of the car, and as noted above softens the strain of the main body of projected light upon the eyes of those facing the vehicle; furthermore, it illuminates the front of the vehicle, making the vehicle itself visible to those facing it.

In order that the light which passes freely through the screen may contain as small a proportion of slightly errant rays as is practically possible, I make the transparent portion of the screen (in this case the orifice 19) very small and arrange it exactly at the remote focus of the mirror, and I employ a source of illumination of small extent and arrange it as nearly as possible at the proximate focus. Thus I am enabled to intercept and diffuse to useful purpose a sufficiently large proportion of the light emitted, this being substantially all of the errant and otherwise objectionable rays.

Lens 22 is as I have said conveniently mounted on screen 18. It is preferably made adjustable with respect to the focus B of the mirror, to the end that the degree of deflection and concentration of the subtended rays may be varied. I shall here describe the means of supporting and of adjusting lens 22 in its support, but it will be understood that in these particulars my showing is exemplary merely. A cylindrical extension 20 is formed on screen 18; in this extension is secured an internally threaded bushing 21; lens 22, carried in an externally threaded collar 23 is mounted in this bushing. The collar 23 is provided with lugs 24 and these engage the lens and hold it in place. As particularly shown in Fig. 2, lugs 24' may be bent across the radially disposed edges of the sector-shaped lens, to hold it against turning in collar 23. The screw-threaded engagement of collar 23 in bushing 21 affords the desired adjustability, and the delicacy of adjustment manifestly is dependent on the pitch of the threads.

The cylindrical extension 20 upon screen 18 will, like the screen itself, preferably be made of glass. Bushing 21 and collar 23 may be made of metal, and if made of metal may manifestly be cut away in large part, to allow fuller passage of light. The light which passes is diffused light which has already passed through the adjacent areas of the translucent portions of screen 18.

The light-directing and light-transmitting parts of the lantern may be colored in whole or in part, as desired.

I claim as my invention:

1. In a lantern the combination of an ellipsoidal mirror, a source of light arranged at the proximate focus of said mirror and an incomplete and sector-shaped lens arranged adjacent the remote focus of said mirror and there subtending the rays on one side of the axis of the emanated pencil of light, the construction permitting the free emanation of the rays on the other side of the axis of the pencil.

2. In a lantern the combination of an ellipsoidal mirror, a source of light arranged at the proximate focus of said mirror, a non-transparent screen arranged in front of said mirror and permitting unobstructed passage of regularly reflected rays, and an incomplete lens arranged adjacent the remote focus of said mirror and subtending the rays of light on one side only of the axis of the projected pencil of light.

3. In a lantern a source of illumination, and means for gathering the emanated rays and projecting them to and beyond a focus in a pencil of light, means for causing the rays of light on one side of the axis of said pencil to advance with a rate of variation in degree of concentration different from the rate obtaining on the other side, and means for changing the ratio between the two said rates of variation.

4. In a lantern a source of illumination, means for gathering the emanated rays and projecting them to and beyond a focus in a pencil of light, a sector-shaped lens arranged adjacent such focus concentric with such pencil and intercepting a portion and only a portion of such pencil and effecting a diminution of the dispersion of the rays of so much of the pencil as it intercepts.

5. In a lantern the combination of a source of illumination, means for gathering the emanated rays and projecting them to and beyond a focus in a pencil of light, and a sector-shaped condensing lens arranged beyond and adjacent to such focus and concentric with the pencil of light so projected.

6. In a lantern the combination of an ellipsoidal mirror, a source of light arranged at the proximate focus of said mirror, and a screen closing the otherwise open end of the mirror, such screen conforming in shape to a dome which intersects the remote focus of the mirror, and being transparent at the remote focus of the mirror and elsewhere non-transparent.

7. In a lantern the combination of a source of illumination, means for gathering the emanated rays and projecting them to and beyond a focus in a pencil of light, and a condensing lens cut away to its center point concentrically arranged in the path of such

pencil and beyond such focus and so as to decrease the angle of final dispersion of the subtended rays.

8. In a light-projecting lantern, the combination of an ellipsoidal mirror, a source of illumination arranged at the proximate focus of said mirror, and a forward-extending screen closing the otherwise open end of the mirror, such screen extending forward to and in its extent intersecting the remote focus of the mirror, and being transparent at the remote focus of the mirror and elsewhere non-transparent.

9. In a light-projecting lantern, the combination of an ellipsoidal mirror having its two foci within the outlines of the lantern, a light source arranged at the proximate focus, and a highly translucent screen arranged at the remote focus and being rearwardly freely exposed to the forward-directed light from both mirror and light source, said screen having a small transparent opening at and immediately encircling the remote focus permitting the free passage of substantially all and only the rays directed to and adjacent said focus, and said screen outwardly constituting a brightly illuminated, light-diffusing, background for the projected pencil of rays, and affording substantial diffused forward and lateral illumination.

10. In a light-projecting lantern, the combination of an ellipsoidal mirror, a light source arranged at the proximate focus, and a highly translucent screen arranged in the path of the forward-directed light and to

the rearward of the remote focus, said screen encircling the axis of the mirror and extending forward and inward to said remote focus, and having at and immediately surrounding the remote focus a small transparent opening permitting free passage of rays directed to and adjacent said focus, and said screen outwardly constituting an illuminated, light-diffusing, background for such freely transmitted rays, and affording diffused forward, lateral and rearward illumination.

11. In a light-projecting lantern, the combination of an ellipsoidal mirror, a light source arranged at the proximate focus of said mirror, a light diffusing non-transparent screen arranged in front of said mirror but having a transparent portion adjacent the axis of the mirror permitting free passage of rays directed toward the remote focus of said mirror, and an asymmetric lens arranged adjacent said remote focus, subtending an incomplete peripheral portion of the projected pencil of light and decreasing the angle of final dispersion of such portion and only of such portion.

Signed at Pittsburgh, in the county of Allegheny and State of Pennsylvania, this twenty-first day of September, 1914, in the presence of subscribing witnesses.

IRA DWIGHT WORCESTER.

Witnesses:

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EFFIE R. EDWARDS,
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