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The Elimination of Automobile Headlight Glare

A properly focused beam. Lamp too far from reflector.

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The Elimination of Automobile Headlight Glare

BY

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The amount of discomfort and even danger suffered by the driver who has occasion to motor along the country roads at night, is undoubtedly sufficient cause for the attempts of various state and city legislative bodies to enact so-called anti-glare ordinances designed to remedy or to eliminate the trouble. The average driver generally knows little about the causes of glare and about what he can do to secure the best possible illumination with the least possible glare from the lamps with which his car is provided. That the members of legislative bodies have a very hazy conception is evidenced by the number of ordinances which have embodied terms as vague as "must not glare or dazzle" or which have attempted to limit candle power of the source.

The purpose of this article is to explain briefly in non-technical terms some of the conditons which exist on cars with headlights in condition as commonly found, to explain why the results are unsatisfactory and what can be done to improve them, and finally, to explain the principle of a few of the anti-glare devices which are becoming popular. The reader who desires to make a very thorough study of this subject should secure the April, 1917, issue of the bulletin of the Society of Automobile Engineers, which contains a very complete discussion of this subject in all its phases.

Figs. 1 and 2 illustrate the light distribution from two differ-

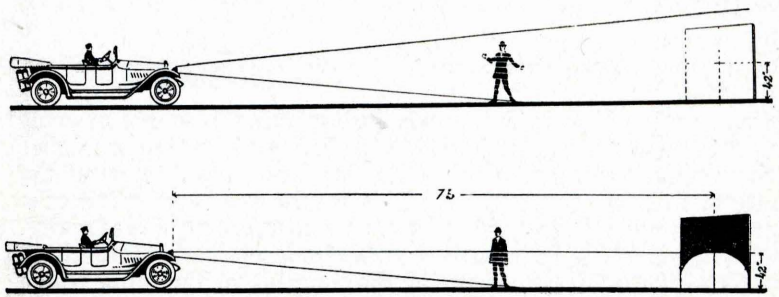


Fig. 1. An incorrectly directed beam of light.
Fig. 2. Correctly directed beam of light.

ent headlights. In the first, much of the beam of light is thrown upward at an angle sufficient to strike the eyes of a man standing, or of the driver of an approaching car. Fig. 2 illustrates the result of having the beam so directed that none of it rises above a height of 42 inches.

With the reflector of the lamp curved to the proper (parabolic) shape, and with a bulb with a filament concentrated almost at a point and placed at the proper location in the axis of the reflector, the *reflected* light would be in the form of a parallel beam, as shown in Fig. 3. A small amount of unreflected light

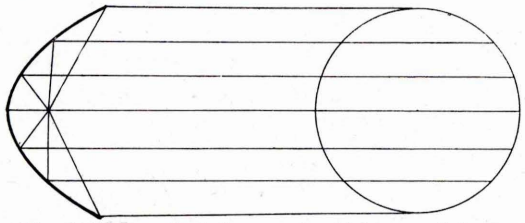


Fig. 3. The reflected rays should be parallel.

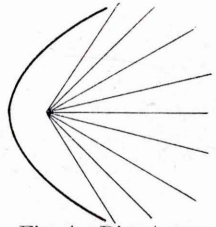


Fig. 4. Direct rays spread in all directions.

would be thrown out over a wide range, as indicated in Fig. 4. The reflected beam should give the illumination to make distant objects visible, and the direct light should illuminate the road close to the car. It is the reflected light beam and not the direct light which causes the most objectionable glare.

Unfortunately, the filament in the lamp bulb occupies a considerable space instead of being concentrated at a point, and generally the lamp bulb is not placed in the proper position relative to the curved surface of the reflector, that is, it is "out of focus." Fig. 5 represents the shape of filament commonly used in the vacuum type or "type B" Mazda or Tungsten bulb. Fig. 6 illustrates the form of filament used in the "nitrogen

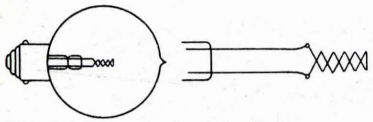


Fig. 5. The filament in the vacuum lamp.

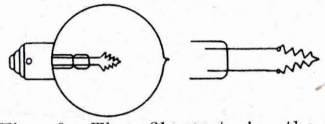


Fig. 6. The filament in the nitrogen filled lamp.

filled" or "type C bulb." This bulb contains nitrogen or some other inert gas, and the filament can be heated to a much higher temperature without danger of its blackening the interior of the bulb or burning out rapidly. This results in the securing of a larger amount of light with the same consumption of electricity.

Faulty lighting frequently results from looseness of the bulb in its socket or displacement of the filament in the bulb, which sometimes takes place while the filament is hot. It may also be

caused by the almost universal condition of improper distance of the bulb or filament from the reflector, even if it is at a proper height.

An inspection of the construction of the lamp and the back of the reflector will generally make evident what must be done to move the bulb forward or backward. If a bulb 1½ inches in diameter is replaced with one 2 1-16 inches, and no adjustment is made, it is evident that the filament will not be in the correct location. No bulb in which the filament is not located as nearly as possible in the center of the globe will be satisfactory for a head lamp, as the rays reflected from the inside surface of the bulb will cause objectionable stray light.

Fig. 10 illustrates how the light is slightly spread instead of being in the form of a parallel beam. This is due to the fact that the filament occupies considerable space instead of being concentrated at a point.

If the filament is located a considerable distance behind the correct focal point, the light rays will diverge, as shown in Fig. 11. The image thrown upon a distant surface, like the wall of a building seventy-five feet away, will be a large circle with a black spot at the center.

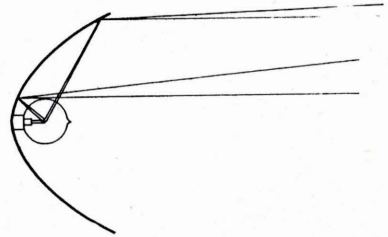


Fig. 10. The filament is not concentrated at a point and the reflected light is not in a parallel beam.

As the filament is moved forward closer to the correct location, the image is reduced in size and increased in brilliancy until the condition illustrated in Fig. 13 is obtained. This is the maximum illumination obtainable and the bulb may be said to be "focused" properly. As the filament is moved still further forward, conditions similar to those obtained when it was behind the focal point will result, Fig. 14 and 15. If one watches a number of cars driven in the fog or along a dusty road, he will notice immediately that more than half of them have the lamps so adjusted and so aimed that either the greater part or all of the light shines not on the road but up into the air.

Some of the first anti-glare devices consisted of metal covers arranged directly in front of the lamp door, or of pieces of paper cut to fit on the inside. These cut off the light passing thru the upper half of the door. If the bulb happens to be in such a location that the rays are diverging, this proves effective as illustrated in Fig. 16. If, however, the bulb is so located that the rays are converging, the only part of the reflected beam to leave the lamp is thrown upward and directly into the eyes of the

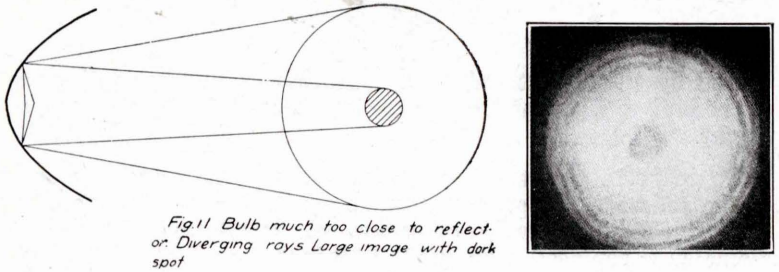


Fig. 11 Bulb much too close to reflector. Diverging rays. Large image with dark spot

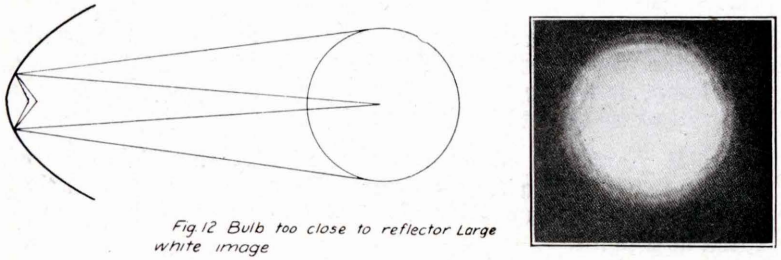


Fig. 12 Bulb too close to reflector. Large white image

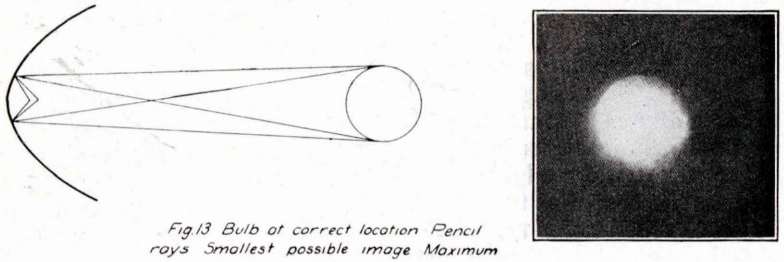


Fig. 13 Bulb of correct location. Pencil rays. Smallest possible image. Maximum illumination

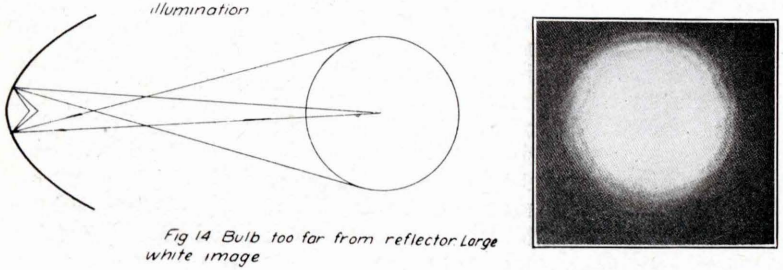


Fig. 14 Bulb too far from reflector. Large white image

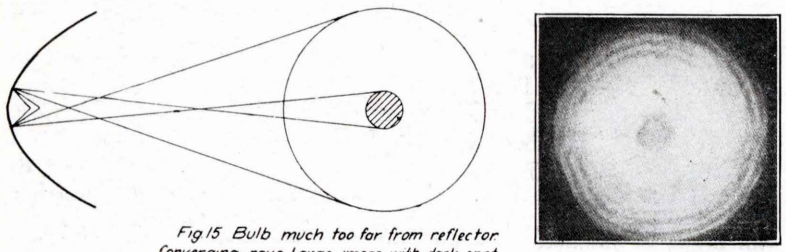
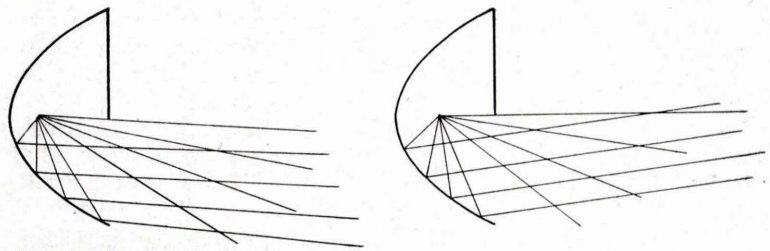


Fig. 15 Bulb much too far from reflector. Converging rays. Large image with dark spot



Figs. 16, 17. Covering the top of the lamp door eliminates the glare only when the bulb is behind the focal point of the reflector.

driver of an approaching car, and the only illumination on the road is that directly in front of the wheels of the car, Fig. 17. The reader can readily see that one location of the bulb calls for the covering of the upper half of the door and another location of the bulb calls for the covering of the lower half.

The blackening or covering with a special patented metal device of a certain portion of the bulb may produce a desired change in the distribution of light. Whether the lower half or the upper half of the bulb should be covered, in an effort to eliminate glare, depends upon whether the bulb is in front of or behind the proper focal point. When the head lamp is properly directed, that portion of the unreflected light which shines above the horizontal may be slightly objectionable and, at any rate, is useless. In the case of the spot light, none of the unreflected light is desired. The covering of a portion of the bulb with paint or possibly, better yet, with silver or a reflecting metal cover is illustrated in Fig. 18.

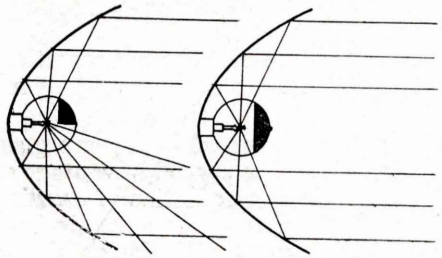


Fig. 18. Silvering or painting a part of the bulb eliminates direct light.

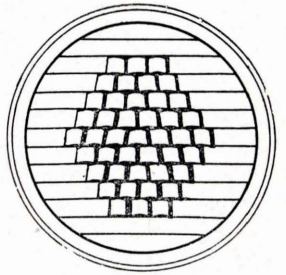


Fig. 19. A series of corrugations diffuse the light horizontally.

If the lamps of a car are properly focused and then the supporting brackets are bent downward at a slight angle, the parallel beam of light can be held below the 42 inch elevation, and excellent illumination with the absence of glare, except at such a time as the car is coming across the crest of a hill, can be obtained, Fig. 1.

The principle underlying the operation of one of the much used anti-glare lenses is illustrated in a section of the lamp shown in Fig. 20. Here the prisms, which form part of the lens (illustrated in Fig. 19) deflect the light downward at a slight angle. The corrugated effect in the glass is for the purpose of diffusing the light horizontally to give illumination to both sides of the road instead of concentrating it. Fig. 21 illustrates on the left the effect of a concentrated beam and on the right the effect of a horizontally diffused beam.

Another form of lens which has become very popular and which to date has been adopted by approximately twenty manufacturers as standard equipment, is illustrated in Fig. 22. The purpose of the small lenses which cover the surface is to diffuse the light so as to increase the illumination close to the car. The

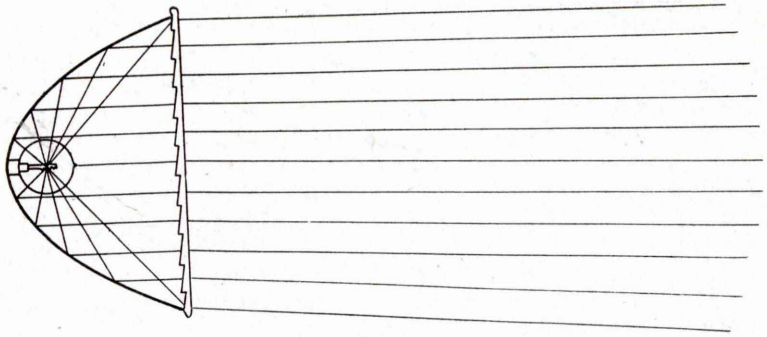


Fig. 20. Prisms in the lens bend the light downward.

glaring effect is reduced to such an extent as to be not objectionable provided bulbs are not replaced by others of very much greater candle power.

One manufacturer has sold large numbers of head lamp glass of amber color rather than white glass. The special advantage of such lenses is that there is less back glare or reflection of dazzling light from particles of moisture in the form of fog or rain back into the eyes of the driver, which makes it difficult for him to see far ahead of the car. Due to the fact that the amber glass absorbs some of the violet and blue rays, there is less total illumination on the road than there would be if white glass were used. Whether or not this is at all serious can be determined by testing illumination, first with a plain glass and then with a special lens.

The market is now flooded with numerous lenses which vary from simply rough or frosted glass, such as is often used in banks and to surround private offices, to very intricate combinations of

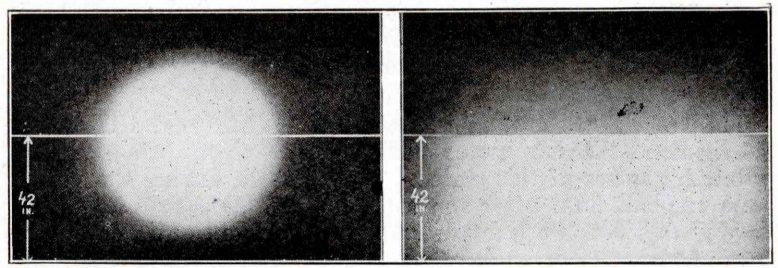


Fig. 21. Prisms and horizontal corrugations, as illustrated in Fig. 19 and 20, direct the light downward and diffuse it.

small lenses and prisms. There are also numerous shields and deflecting devices, many of which, if the bulb be not properly focused, will take all of the illumination from the road and throw it into the face of the driver of the approaching car. Some of the diffusing lenses reduce the illumination ahead of the car by scattering all the light out close to the car or by absorbing a large proportion of it to such an extent that one cannot drive on a strange road at night without suffering extreme eye strain and nervous fatigue. Everything close to the car is far too well illuminated and everything beyond is almost in darkness.

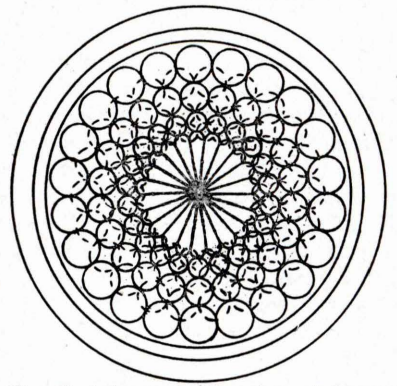


Fig. 22. A large number of small lenses diffuse the light in all directions.

The spot light arranged so the driver can direct it at will is a most useful device if properly used. When two cars meet on a narrow road, it can be directed toward the right to afford the illumination desirable to allow the driver to avoid danger of running into the ditch. It should never be directed toward an approaching car even if the distance is great. Unfortunately, the spot light has been so much abused that legislation has been proposed in many states for its abolishment. Whether it will be allowed depends upon whether it is abused or used properly. In Canada no motor car is allowed to be equipped with a spot light.

The Society of Automobile Engineers has recommended the practice concerning head lamp illumination as follows: "The head lamps shall be so arranged that no portion of the direct reflected beam cone of light, when measured 75 ft. ahead of the lamps, shall rise above 42 inches from the level surface of the

road on which such vehicle stands, under any condition of loading; nor shall any portion of the direct reflected beam cone of light rise, at 75 ft. distance, more than twelve inches above the center of the head lamp.''

The Iowa State law, as revised in 1917, makes the following provisions: ''Every motor vehicle operated or driven up the public highways of this state . . . shall, during the period from one-half hour after sunset to one-half hour before sunrise, display at least two lighted lamps on the front and one on the rear of such motor vehicle, which rear lamp shall also display a red light visible from the rear; provided that each motor cycle and each motor bicycle shall be required to display but one lighted lamp in the front of each motor cycle or motor bicycle. The rays of such rear lamp shall shine upon the number plate carried on the rear of such vehicle in such a manner as to render the numerals thereon visible at least fifty feet in the direction from which the motor vehicle is proceeding. The light or lights of the front lamps shall be visible at least five hundred feet in the direction in which the motor vehicle is proceeding; *provided, however, that it shall be unlawful for any person operating a motor vehicle upon the public highway in this state to use any lighting device of over four candlepower, equipped with a reflector, unless the same shall be so designed, deflected or arranged that the directly defelcted, and undiffused beam of such light, when measured seventy-five feet or more ahead of the light shall rise above forty-two inches from the level surface upon which the vehicle stands under all conditions of load. Spot lights shall not be so used as to throw direct rays in the face of an approaching vehicle.''*

Although there is an error in the wording of the law as it appears in the published copies, the intention of the lawmakers is evident.

It is an easy matter for the driver to stop his car seventy-five feet from the wall of a building, as indicated in Fig. 1, and determine whether his lamps are complying with provisions of the law.

Whether or not objectionable glare exists when lenses designed primarily to diffuse the light are used can generally be determined by walking toward the car from a distance of several hundred feet and looking alternately at objects beside the car and at objects in or at the side of the road close to the observer. In many cases there is no objectionable glare until the distance is less than one hundred feet. Then the light is almost blinding until a point is reached at the side of the headlight. This condition is much worse if the driver, in an effort to regain range or distant illumination, has greatly increased the candle power of his lamp bulbs.

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