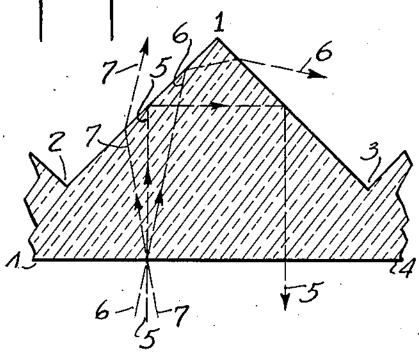
Oct. 3, 1939. T. W. ROLPH 2,175,067

PRISMATIC REFLECTOR

Filed April 23, 1938

Fig. 1.



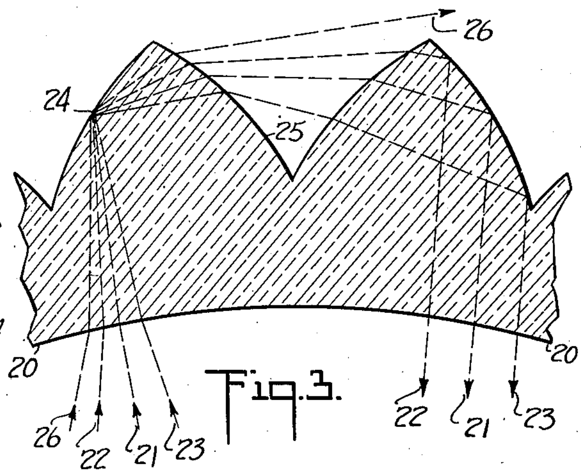
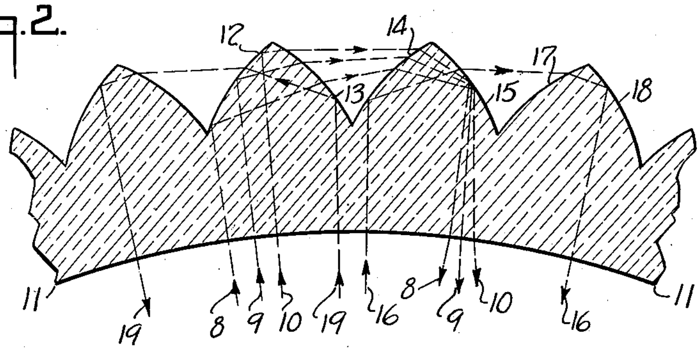




Fig. 3.

Fig. 2.



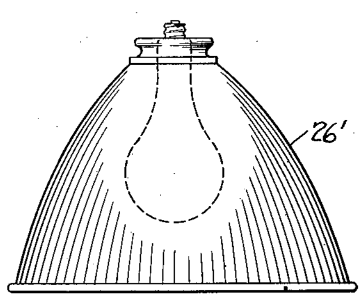
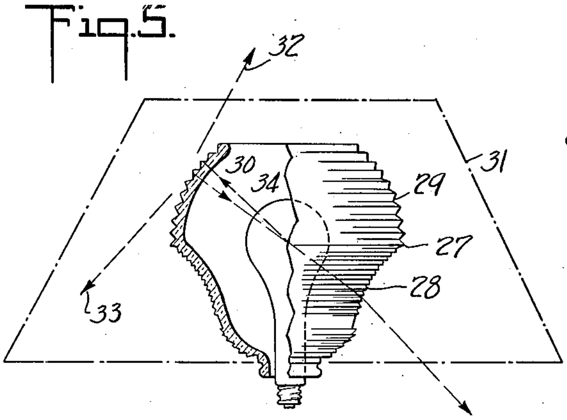




Fig. 4

Fig. 5.

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# UNITED STATES PATENT OFFICE

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## PRISMATIC REFLECTOR

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Application April 23, 1938, Serial No. 203,744

7 Claims. (Cl. 240—106)

The present invention relates to prismatic reflectors.

An object of the present invention is to provide a new reflecting prismatic construction in which the overall efficiency of the reflecting prism construction is increased and the light which is not reflected passes out in certain desirable directions. These objects are accomplished by utilizing prisms in pairs and shaping each prism so that the light is reflected from one prism across the intervening space between the two prisms and after entering the second prism is reflected back in the general direction from which it came.

The outer surface of the average prismatic reflector is provided with a plurality of double reflecting prisms of substantially 90°. The interior face is generally smooth. The new form of prism described herein uses two faces which are curved and which form an angle substantially less than 90° with each other.

The accompanying drawing shows, for purposes of illustrating the present invention two of the many embodiments in which the invention may take form, it being understood that the drawing is illustrative of the invention rather than limiting the same.

In the drawing:

Figure 1 is a cross-section of a 90° double reflecting prism as employed on the surface of a prismatic reflector;

Figure 2 is a cross-section through several prisms of the new type as used on a prismatic reflector;

Figure 3 is a cross-section similar to Figure 2 indicating also the action upon incident light which is converging;

Figure 4 illustrates a typical prismatic reflector with these prisms running radially; and

Figure 5 illustrates a prismatic reflector in which these reflecting prisms are annular, the reflector being used within a shade.

Figure 1 shows in cross section a typical 90° double reflecting prism, as now found in the art, the apex being at 1 and the valleys being at points 2 and 3. 4—4 represents the inner surface of the reflector on which this prism is placed. 5 represents a light ray entering the inner surface 4, reflected successively at the two surfaces of the double reflecting prism and leaving the inner surface in a direction parallel to the direction of incidence. In this figure the light ray is shown as entering the surface at normal incidence. When a light ray enters the surface at angles slightly different from the normal, reflection still occurs at the two surfaces of the prisms, but when the angle of the entering ray is more than a few degrees (the amount depending upon the index of refraction of the medium) away from the normal incidence, transmission occurs at one of the two reflecting surfaces. This is illustrated by rays 6 and 7 in Figure 1.

Figure 2 shows the action obtained with the new form of prism. Light rays 8, 9 and 10 enter the smooth inner surface of the reflector 11—11 normal to the surface and are reflected from the first prism surface 12. They pass across to the second prism surface 13 and are refracted at this surface in the direction of the next prism. They enter the next prism 14 and are refracted at this surface into the proper direction for reflection from the second surface 15 of the second prism. This reflection directs them back through the smooth inner surface of the reflector in the general direction from which they came.

Surfaces 13 and 14 are not refracting surfaces only. They also act as reflecting surfaces to cooperate with other adjacent prisms. For example, light ray 16 enters the smooth inner surface of the reflector and is reflected from reflecting surface 14 across to prism surface 15 where it is refracted and enters the next adjacent prism at surface 17. Here it is refracted again and reflected from the opposite surface 18 of this prism and goes back in the general direction from which it came in the same manner as light rays 8, 9 and 10. Another light ray 19 is indicated using surface 13 as a reflecting surface and entering the adjacent prism on the other side.

It is clear, therefore, that each prism surface acts as a reflecting surface for some of the light rays and as a refracting surface for other light rays. By shaping the surfaces properly, this action can be controlled so that the maximum amount of light is reflected from the first prism and enters the second prism at angles insuring reflection from the opposite surface of the second prism. Note that the light rays entering the inner surface of the reflector at normal incidence and striking reflecting surface 12 at different points along the surface, all tend to converge at the center of the second reflecting surface 15. This indicates that incident light which is not normal to the inner surface of the reflector can still be received and reflected by surface 15, as will now be described in connection with Figure 3.

Figure 3 shows the action of converging light rays received by these reflecting prisms as used on a prismatic reflector. Light ray 21 enters the smooth inner surface 20—20 of the reflector in Figure 3 at normal incidence. It is reflected from the first surface 24 of the first prism, passes across into the second prism and is reflected out again in the same way as the light rays indicated in Figure 2. Light rays 22 and 23, however, do not strike the inner surface 20—20 at normal incidence. This may be due to the fact that the light source is of appreciable size and not all of the light comes from its exact center, or it may be due to other causes such as the light source being somewhat off-center in the reflector. Whatever the cause, it is desirable to deal with this light as efficiently as possible. Within a certain angle or spread, these light rays 22 and 23 are reflected from the first surface of the first prism, refracted at the second surface of this prism, enter the second prism and are reflected out as indicated. It will be seen that although these two light rays 22 and 23 do not enter the inner surface at normal incidence, they are nevertheless reflected back in the general direction from which they came and the reflector, therefore, handles them efficiently.

These light rays 22 and 23 of Figure 3 correspond to light rays 6 and 7 in Figure 1. There is this important difference, however. It is found that in this new form of prism, light rays 22 and 23 may be spread farther from the central light ray and still follow the desired path through the prisms and be reflected back in the direction from which they came. In other words where light rays 6 and 7 in Figure 1 emerge from the reflector on the outside of the prisms, light rays 22 and 23 of Figure 3 do not emerge on the outside of the reflector but emerge on the inside, having been reflected into the desired direction. This results in an increase in the spread of light which can be handled efficiently by a prismatic reflector. In this lies a great advantage of these new prisms. They increase the amount of light which can be reflected from a prismatic reflector as used with the customary forms of light sources.

When the spread of incident light is too great, however, some of this light will be transmitted. Such a light ray is indicated at 26 of Figure 3. This light ray striking the inner surface 20—20 at a considerable angle from the normal ray 21 is slightly refracted and passes to the first surface 24 of the first prism. Here it is reflected and goes on to the second surface 25 of the first prism. Here light ray 26 is transmitted and refracted in the same way as the other light rays, but due to its direction, light ray 26 is refracted at an emerging angle which misses the second prism. While it misses the second prism, it passes out in directions close to the second prism. Hence it emerges in directions nearly tangent to the general contour of the reflector. This is sometimes a decided advantage as will be pointed out below in connection with Figure 5.

Figure 4 shows a prismatic reflector 26′ of the usual form having radial reflecting prisms. Such a reflector is suitable for this new form of prism. The prisms can be placed on the reflector in the same way that customary reflecting prisms are used and an increase in efficiency will be obtained.

Figure 5 indicates a case in which it is advantageous to use the prisms running horizontally around the reflector. This shows a lamp 34 surrounded by a light-director 27. This light-director 27 has a lower portion 28 which is refracting to give a wide spread of light outward and downward. The upper portion 29 is approximately spherical in contour and carries reflecting prisms to reflect the light back toward the refracting portion 28. These reflecting prisms are placed horizontally and are of the form described herein. A light ray 30, for example, leaves the lamp, strikes these reflecting prisms, passes from one prism to another and back in the direction from which it came. This takes it back through the light-source to be handled by the refracting portion 28 in the same way that direct light is handled.

As this globe or light-director is used for portable lamps, it is surrounded by a dense translucent shade 31. This shields the eyes from direct view of the light-director. The light which is transmitted by the reflecting prisms will emerge in directions nearly tangent to the reflecting contour as shown in connection with Figure 3. Such transmitted light is indicated in Figure 5 by light rays 32 and 33. Light ray 32 is typical of the light emerging in a generally upward direction and passing out through the opening in the top of the shade. Light ray 33 is typical of the light emerging in a generally downward direction and passing out through the lower opening in the shade. Thus the transmitted light leaves the surface of the light-director in directions nearly tangent to its contour and such light generally misses the shade and passes out either in downward directions to be directly useful or in directions toward the ceiling to add to the general diffusion of light in the room. With the ordinary form of reflecting prism as indicated in Figure 1 this would not occur because much of the light which is not reflected would be transmitted in directions to strike the shade 31.

If the prisms on the reflecting section 29 of the light-director were run vertically, they would still act efficiently as reflectors but the transmitted light would emerge in directions to strike the shade 31. In this light-director, best efficiency is obtained by using prisms of the new form running horizontally on the reflecting portion.

It is obvious that the invention may be embodied in many forms and constructions within the scope of the claims and I wish it to be understood that the particular forms shown are but a few of the many forms. Various modifications and changes being possible, I do not otherwise limit myself in any way with respect thereto.

What is claimed is:

1. A prismatic reflector having its prisms adjacent one another and separated by intervening air spaces, each prism having two curved faces concave toward each other, symmetrical with respect to a central prism axis and intersecting at an apex, one face of each prism intercepting a light ray in the medium of the reflector generally parallel with the prism axis and reflecting it toward the opposite face of said prism, which refractively transmits it across the air space between consecutive prisms, the adjacent prism having its externally convex refracting surface, onto which said ray impinges, for deviating said ray toward the opposite surface of said adjacent prism at such angles that said opposite surface will totally reflect it into a direction substantially parallel with the axis of the said adjacent prism.

2. A luminair comprising a light source of substantial size, a prismatic reflector about the light source and having a series of external prisms with their axes converging toward the light source, each prism having a reflecting face adapted to receive convergent light from the source for redirecting such light across the prism and a refracting face for transmitting such redirected light outside the refractor in a divergent beam of

greater angle than the original angle of convergence with the dominant portion of said divergent beam at angles subtended by the next prism of the series, the next prism in the series having a light condensing incident face for transmitting the light across said prism and a reflecting face for condensing it to substantially the original angle of convergence and returning it toward the source.

3. A luminair such as claimed in claim 2, wherein the reflector is of arcuate contour transversely of the prisms and light rays emerging from the tips of the prisms and emerging between the prisms at angles substantially greater than 90° with the prism axis are transmitted in directions generally parallel with the profile of the reflector.

4. A prismatic reflector having a series of prisms adjacent one another and separated by intervening air spaces, each face of each prism being a light reflecting face for light rays in the medium falling on said face at the angles effective for total reflection and reflecting said rays at such an angle as to direct them onto the opposite face of the prism for refractive transmission thereby across the air space toward the adjacent prism, each face of each prism being adapted to receive light transmitted as aforesaid and refract it toward the opposite face of the same prism for reflection thereby into a direction substantially parallel with that of the original ray.

5. In combination two adjacent prisms with faces at less than 45° to the prism axis, the prism axes being substantially parallel, the remote faces of the prisms being at such angle to the prism axes as to totally reflect light rays parallel, or approximately parallel, with the axes and incident thereon, the adjacent faces of adjacent prisms being refractors for the said reflected rays and placing them on the said remote faces at such angles thereto as to be totally reflected thereby into directions substantially parallel with the direction of the original rays.

6. In combination two adjacent prisms with outwardly convex faces at less than 45° to the prism axis, the prism axes being substantially parallel, the remote faces of the prisms being at such angle to the prism axes as to totally reflect light rays parallel, or approximately parallel, with the axes and incident thereon, the adjacent faces of adjacent prisms being refractors for the said reflected rays and placing them on the said remote faces at such angles thereto as to be totally reflected thereby into directions substantially parallel with the direction of the original rays.

7. A prismatic reflector having two internal light reflecting surfaces and two light refracting surfaces the four surfaces being juxtaposed to form two adjacent ribs and effect a reversal of the general direction of a light ray originating in a direction at which the first reflecting surface on which it falls acts to totally reflect the ray.

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