No. 720,386. PATENTED FEB. 10, 1903.

F. L. O. WADSWORTH.

ILLUMINATING PRISM STRUCTURE.

APPLICATION FILED JULY 12, 1900.

NO MODEL.

Fig. 1.

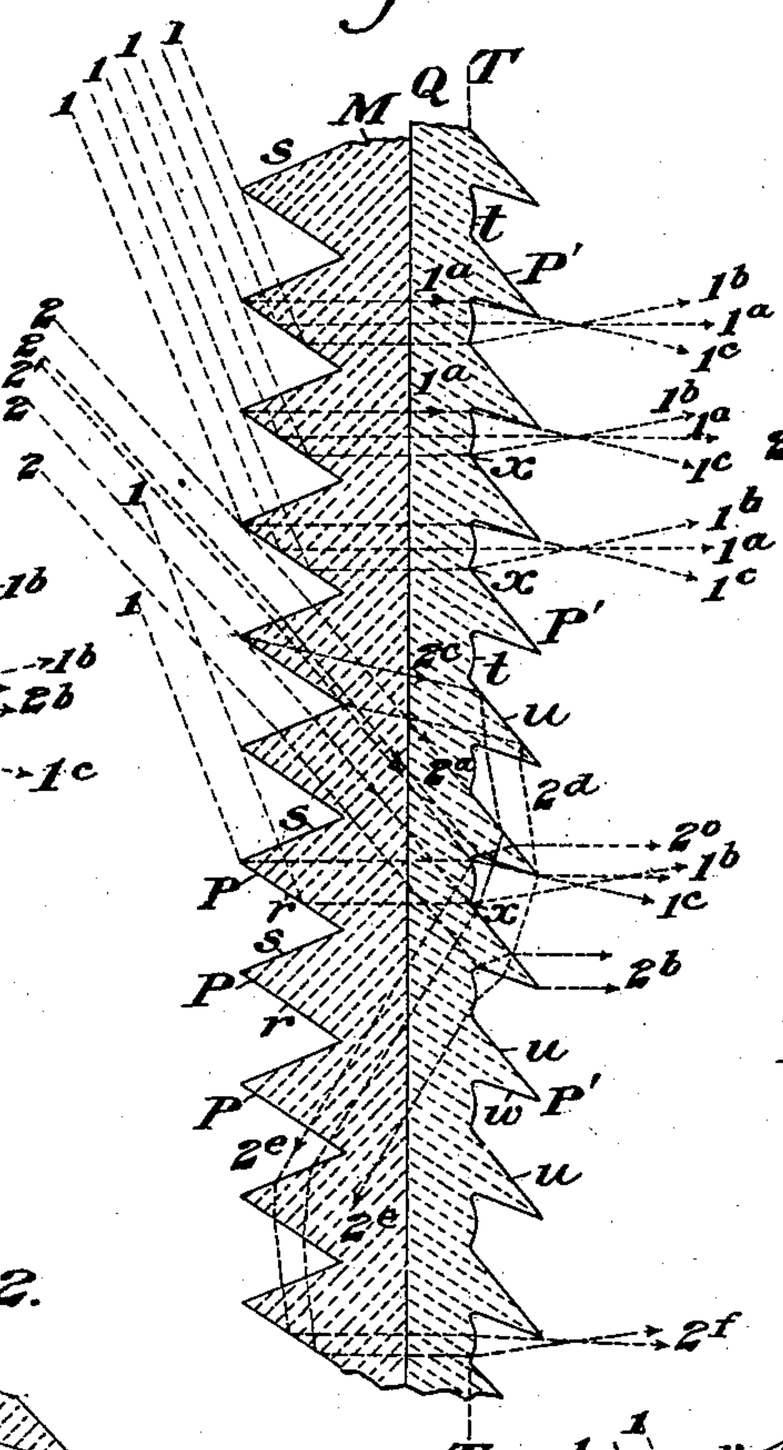


Fig. 5.

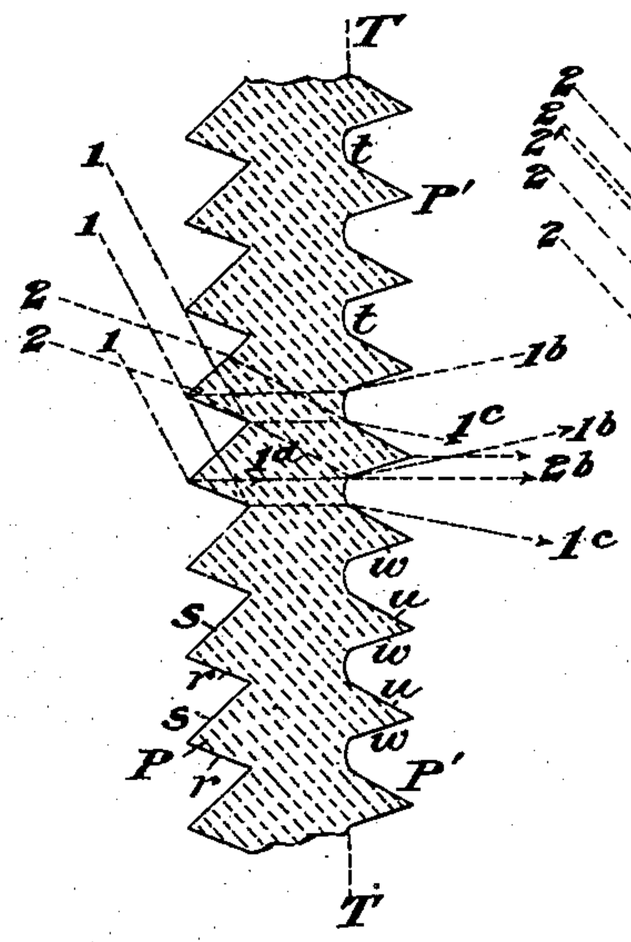


Fig. 4.

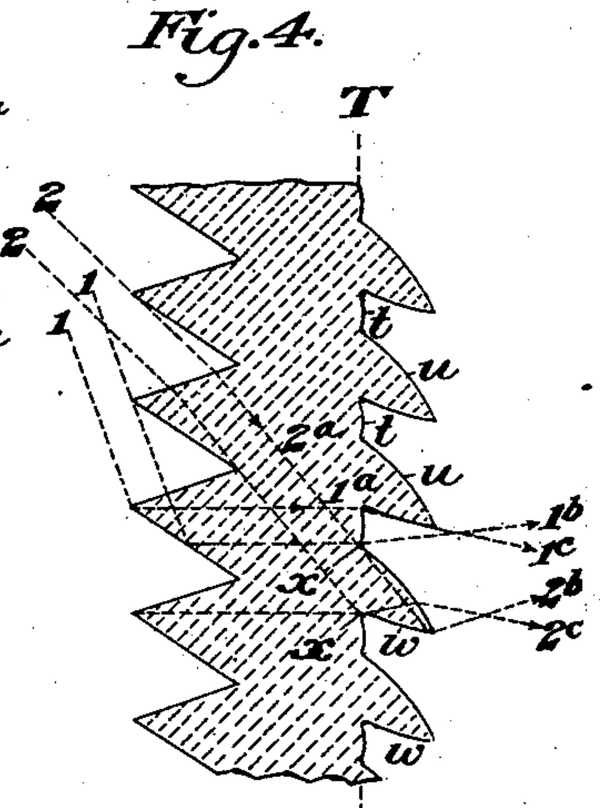


Fig. 3.

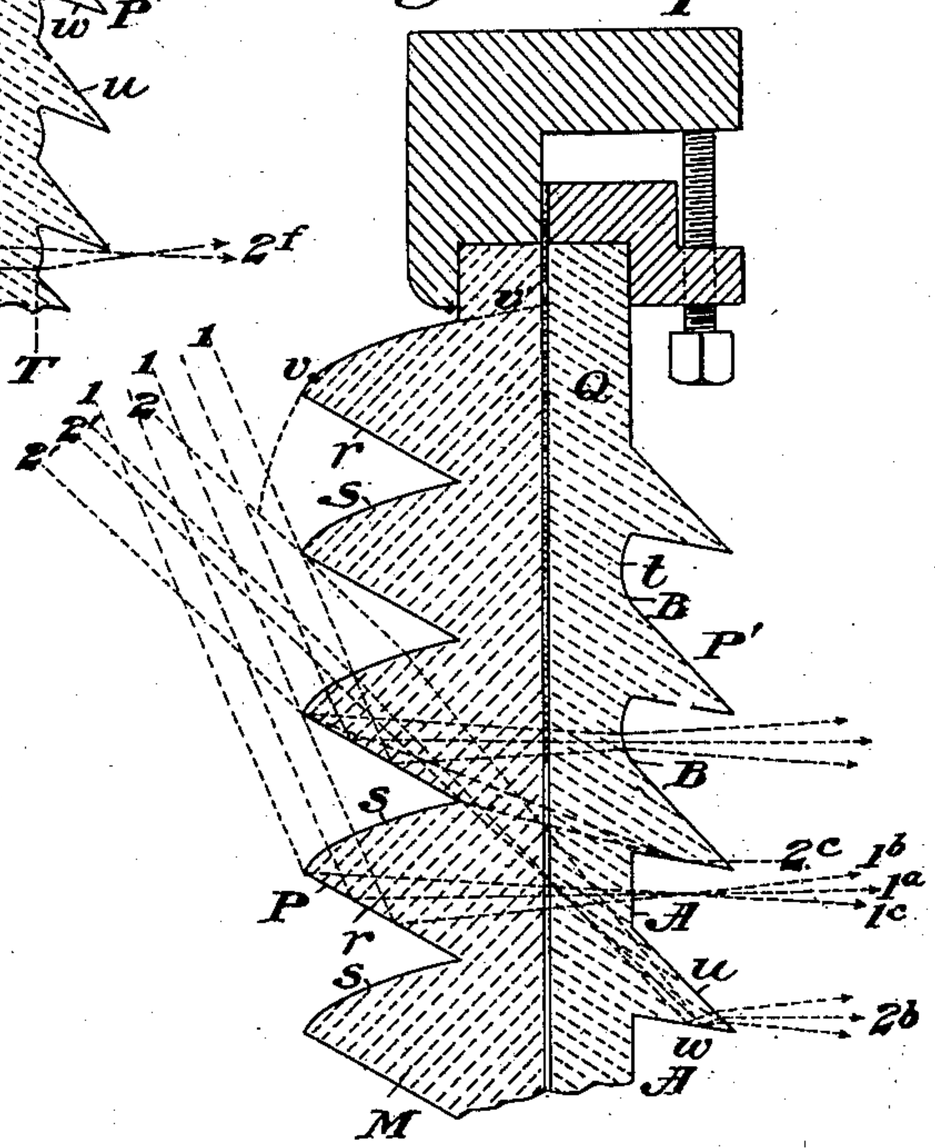
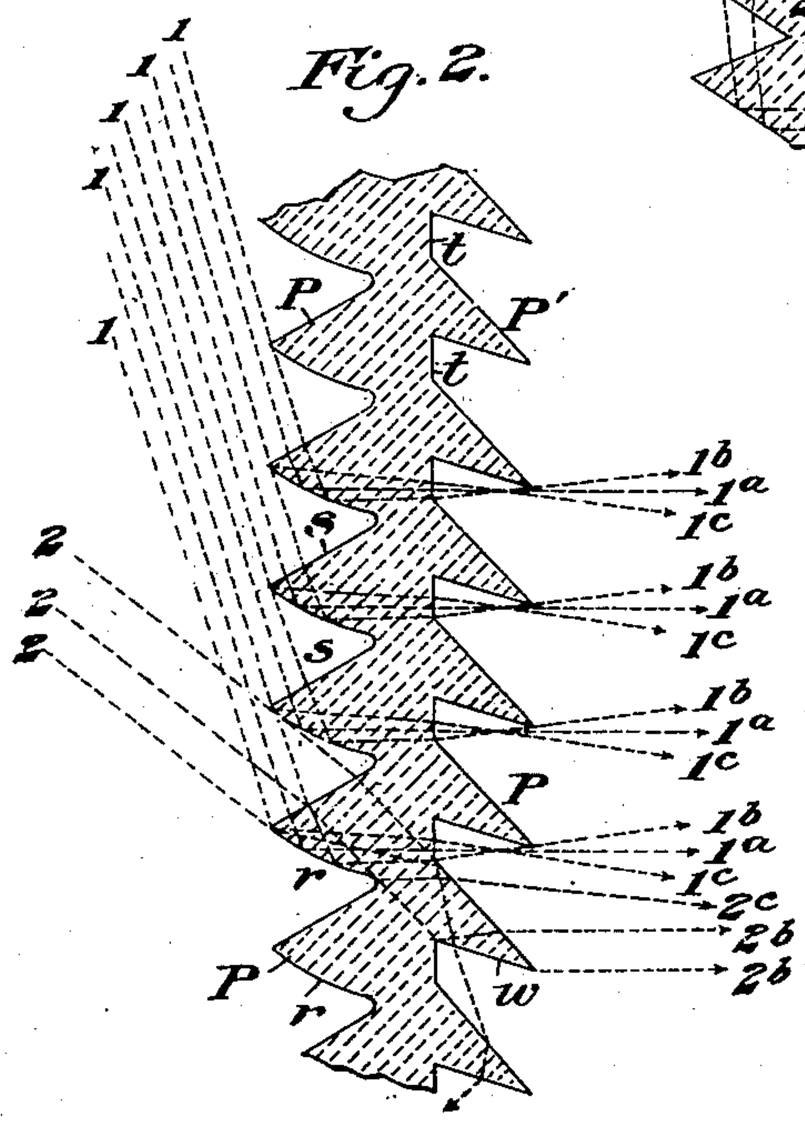


Fig. 2.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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ILLUMINATING PRISM STRUCTURE.

SPECIFICATION forming part of Letters Patent No. 720,386, dated February 10, 1903.

Application filed July 12, 1900. Serial No. 23,315. (No model.)

To all whom it may concern:

Be it known that I, FRANK L. O. WADSWORTH, of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Illuminating Prism Structures, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 represents in cross-section a portion of my improved form of structure, and Figs. 2, 3, 4, and 5 represent modifications.

The object of my invention is to obtain an improved illuminating structure which will efficiently utilize the light incident upon it from two or more directions, as the conditions under which illuminating structures are used frequently require that light received from two or more different sources of illumination on the outside shall be directed in substantially the same direction into the space to be illuminated. In my improved construction this is accomplished by providing the structure with a series of prisms on the front or incident side which are so designed as to receive the light from the principal source of illumination and deflect it in the required direction through a series of substantially parallel dioptical surfaces on the emergent side and at the same time to receive the rays from the secondary source of illumination and direct them at an angle upon a second series of prisms on the emergent side, by which they are deflected into the room in a direction substantially parallel to that taken by the first set of rays. Thus in Fig. 1 the rays 1 1 1, falling upon the receiving sides *s s* of the prisms P P, are refracted thereat to the faces *r r* of the same prisms, from which they are reflected toward the emergent side of the plate, as at 1^a 1^a, and there fall upon surfaces *t t*, which in general outline and position are substantially parallel to the general plane of the structure and which therefore transmit these rays without substantial change of direction. When a certain dispersion of the rays behind the structure is desired in order to more fully illuminate the apartment, these surfaces *t t* may be curved, so as to disperse the bundle of rays 1^a 1^a, as at 1^b 1^c. A further object of thus curving the surfaces in the case of such structures as those shown in Fig. 1 is to enable the emergent bundles of rays to pass the points of the intermediate prisms P′ P′, which are placed on the emergent side between the surfaces *t t* for the purpose, as already stated, of receiving and directing into the room rays of light from a secondary direction. Part of these rays, such as 2 2, fall first on the surfaces *s s* of the prisms P on the front of the structure and are there refracted in the direction 2^a 2^a and received on the faces *w* of the prisms P′, whence they are reflected to the face *u* of these same prisms and thence pass into the room in the direction 2^b, parallel to the general direction 1^a of the primary rays. Another part of these rays, such as 2′ 2′, after refraction at the faces *s s* fall upon the surfaces *r* of the prisms P, are reflected thereby in the direction 2^c, meet the surfaces *u* of the prisms P′, are reflected thereby through the faces *w* in the directions 2^d, fall upon the prism elements P′ just below, and are by them turned back by refraction through the body of the prism-plate in the direction 2^e, finally emerge from the front of the same, and falling upon the prisms P on this side are again turned back, first by refraction and then by reflection, at one of the faces *r* of said prisms, so as to finally emerge through one of the faces *t* on the rear side of the structure in directions 2^f, substantially parallel to the directions 1^a 2^b of the preceding sets of rays.

In the modifications shown in Fig. 2 the relations and actions of the two sets of prisms P P P′ P′ and of the intermediate surfaces *t t* are similar, the only difference being that in this case the surfaces *r* of the prisms P are curved, so that the bundles of rays directed therefrom from the principal direction are converged, as at 1^a 1^a. The advantage of this arrangement in certain cases is that a smaller area of emergent surface *t t* is necessary for the transmission of the entire body of these rays, and the prisms P′ may therefore be larger than in the preceding case, and thus

receive a larger proportional part of the rays from the secondary direction 2 directly upon the faces *w w*. In Fig. 3 a similar arrangement of parts is shown; but in this case the receiving-faces *s s* of the prisms P are curved, and as a result both the rays from the direction 1 and from the direction 2 are converged when they strike the surface. As before, rays from the direction 1 are reflected directly at the surface *r* in a convergent bundle toward the rear of the prism-plate and pass through the surfaces *t t*, which may be either flat, as at A A, or concave, as at B B, Fig. 3. The rays from the secondary direction 2 2 are refracted at *s*, pass in converging bundles to the surfaces *w* of the prisms P′, and are thence reflected as before into the room in the direction 2^b 2^c.

In the case of such structures as those shown in Figs. 2 and 3 the faces of the prisms P may have any curvatures desired. In most cases the best results will be secured, as pointed out more fully in my applications Serial Nos. 687,134 and 687,132, when the faces *r* coincide in cross-section with portions of parabolic curves and the surfaces *s* coincide in cross-section with portions of hyperbolic curves, as at *v v′*, Fig. 3. In some cases I may also make one or both faces of the prisms P′ P′ curved, as in Fig. 4, the object and result of this being also to disperse the bundles of secondary rays deflected by these prisms, as at 2^b 2^c. In other cases the prisms on the emergent side may be refracting in character, as in the modification illustrated in Fig. 5, in which the bundles of secondary rays from the direction 2 2 after refraction at the faces *s s* of the prisms P P are received on the faces *w w* of the second set of prisms at such an angle as to be refracted thereat into the space behind the plate in the required direction 2^b. The rays of light from the principal direction 1 1 are after deflection at the faces *r r* of the prisms P P received as before on intermediate dispersing-surfaces *t t* and thence transmitted in the directions 1^b 1^c. The intermediate surfaces *t t* may be flat, as shown in Fig. 2 and at A A in Fig. 3, convexly curved, as in Fig. 1, or concavely curved, as in Figs. 3 and 5. In all these cases they act as dispersing-surfaces—*i. e.*, they alter the angular divergence or convergence of the bundles of rays which fall upon them. In the first two cases this occurs because the bundles of rays falling upon these surfaces are convergent, in the last two cases because the surfaces themselves are curved. I therefore designate these surfaces by the general term "dispersing-surfaces."

In laying off the surfaces of the structure so as to utilize most fully the rays from both the principal and secondary directions I first lay off the prisms P on the front side of the structure with the surfaces *s s* preferably nearly perpendicular to the direction 1 1 of the principal incident rays and with surfaces *r r* at such an angle that these rays are reflected in the required direction 1^a. I next determine the direction 2^a which the rays 2 take on refraction at the surfaces *s* and then locate the general plane T T of the surfaces *t t* so that the largest possible proportion of the rays 2^a may be received by the prisms P′ intermediate between the surfaces *t t*. This will in general be the case when the lower edges of the faces *t t* meet the upper edges of the prism-faces *u u* at the points of intersection *x x* of the lower rays of the bundles from the direction 1 1 with the upper rays of the bundles from the direction 2 2. I then lay off the surfaces *u* and *w* of the prisms P′ so as to transmit the rays 2^a in the direction 2^b.

In building up these structures the plate may be made either in one integral piece, as in Figs. 2, 4, and 5, or in two parts M Q, as in Figs. 1 and 3. In the latter construction the plates may be cemented together with transparent cement or flux or may be separated slightly and the intervening space filled with liquid of substantially the same index of refraction as the glass itself, as in Fig. 3. In this last case the two plates may be mounted, as in Fig. 3, so as to be movable one with respect to the other, thus enabling me by adjusting one longitudinally to regulate at will the amount of light sent in a given direction. This general means of regulation I do not here claim broadly, as it is made the subject of another application for Letters Patent, Serial No. 694,828.

Without limiting myself to the specific forms or constructions herein shown, I claim—

1. An illuminating structure having on one side a series of prisms and on the other a second series of prisms parallel to the first, and a series of dispersing-surfaces arranged between the prisms; substantially as described.

2. An illuminating structure having on the first or receiving side a series of prisms, and on the discharging side a second series of smaller prisms parallel to the first and separated by a series of dispersing-surfaces; substantially as described.

3. An illuminating structure having on the first or receiving side a series of prisms substantially parallel to the general plane of the structure, and on the discharging side a second series of smaller prisms parallel to the first and separated by a series of dispersing-surfaces; substantially as described.

4. An illuminating structure having on one side a series of prisms with receiving and deflecting sides, and on the other a composite discharging-surface consisting of a series of dispersing-surfaces transversely opposite the deflecting sides of the first prisms and placed alternately with relation to a series of smaller prisms; substantially as described.

5. An illuminating structure having on one

side a series of prisms and on the other side a second series of prisms parallel to the first, and a series of dispersing-surfaces arranged between the prisms, with means for moving the second series of prisms and dispersing-surfaces with reference to the first; substantially as described.

In testimony whereof I have hereunto set my hand.

F. L. O. WADSWORTH.

Witnesses:
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