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MTR2D XR 593,348

(No Model.) 2 Sheets—Sheet 1.

A. BLONDEL & S. PSAROUDAKI.

REFLECTOR.

No. 593,348. Patented Nov. 9, 1897.

Fig 1.

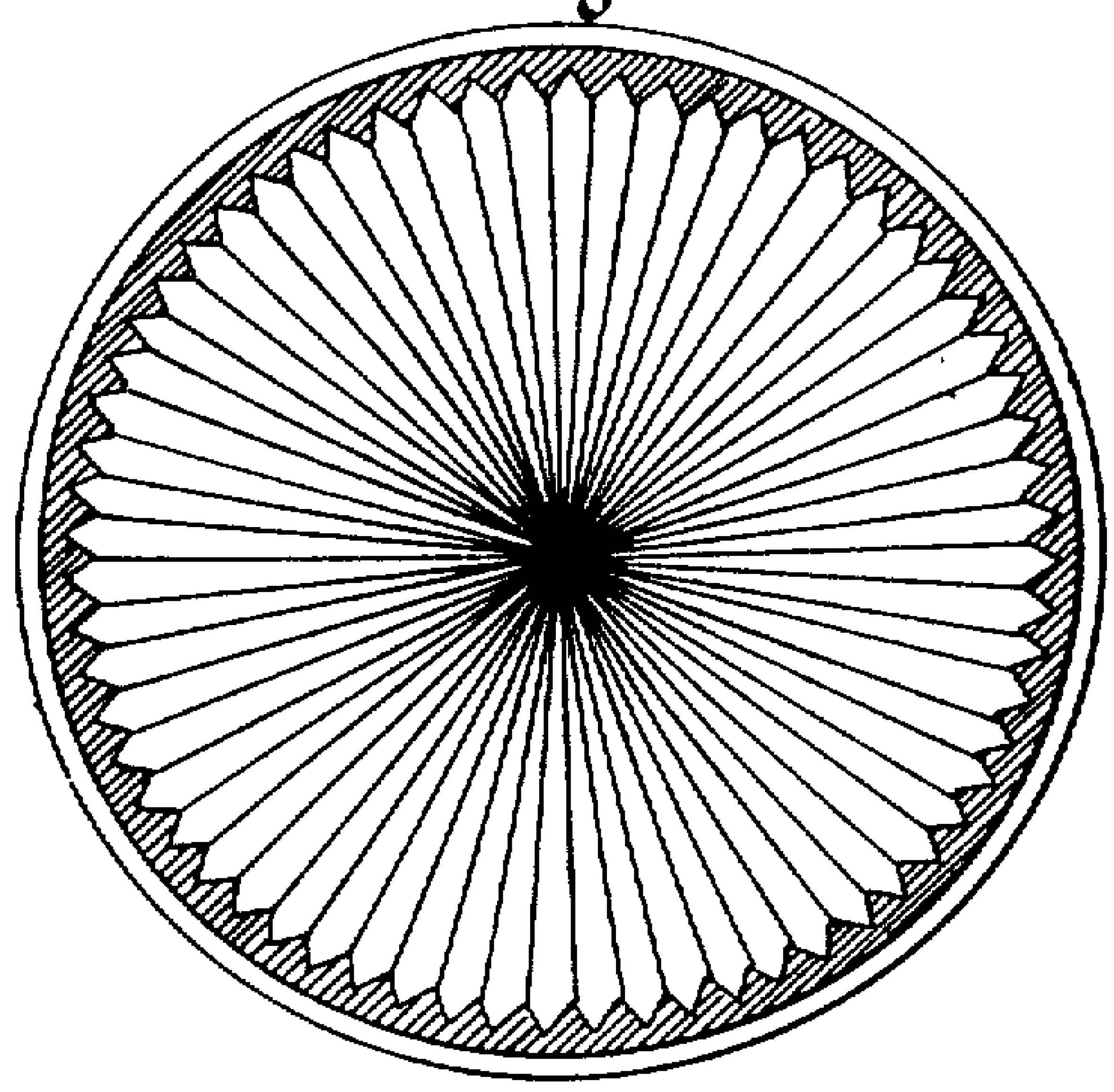
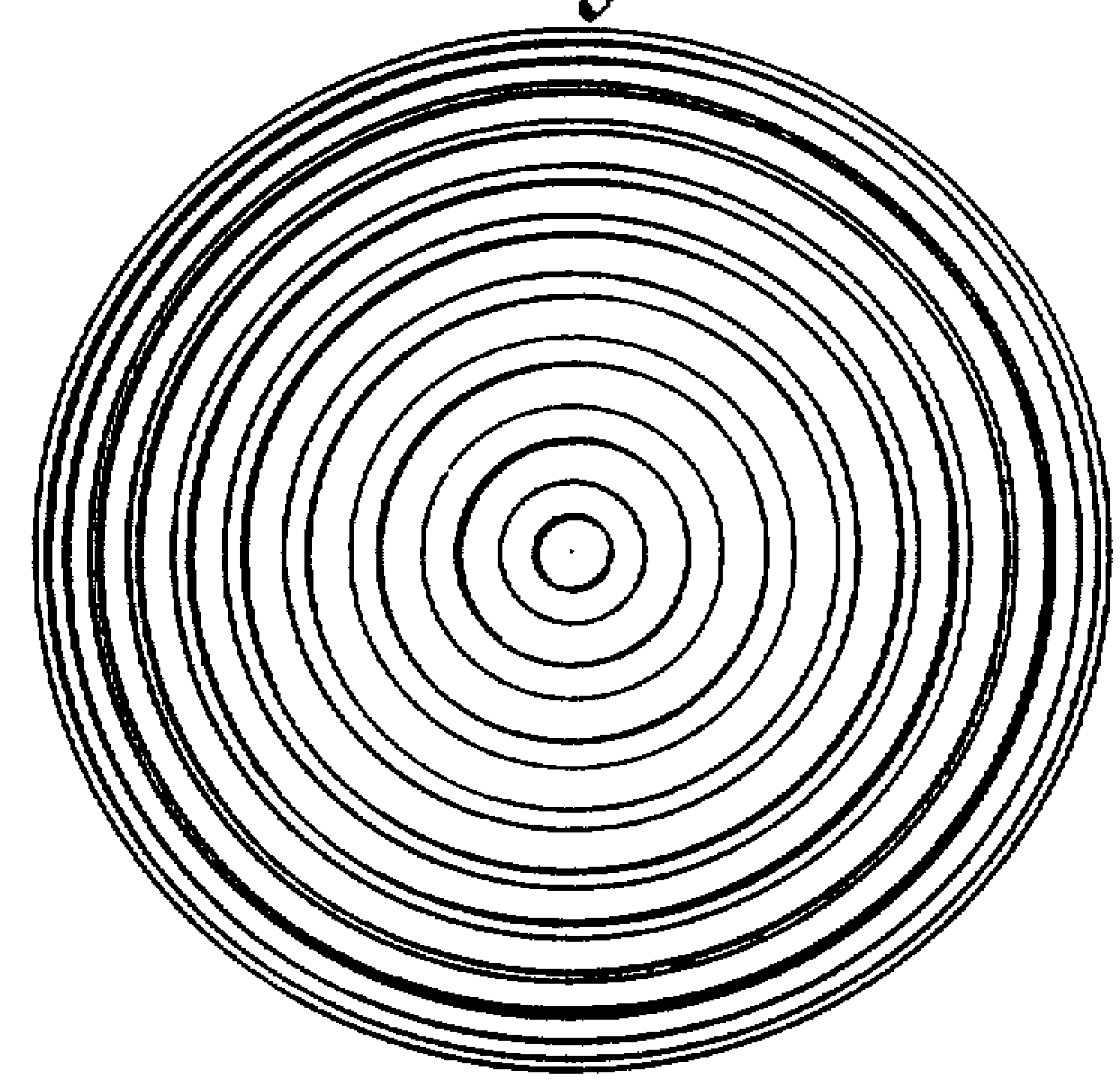


Fig 2.



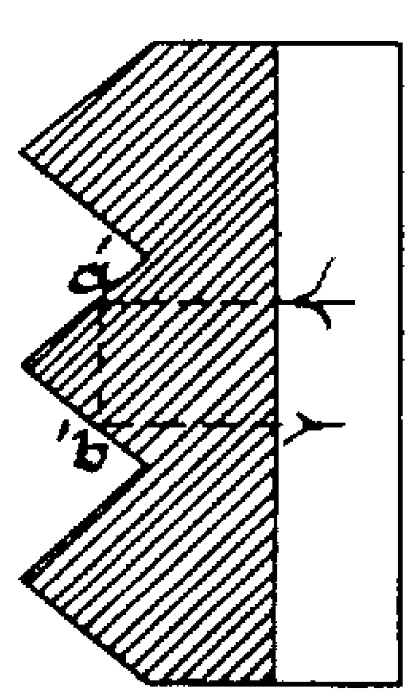


Fig 3.

Fig 4.

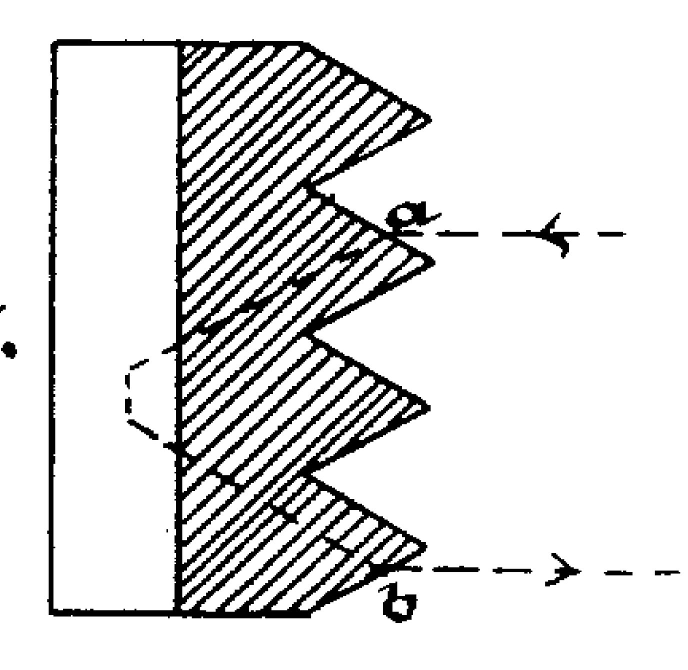
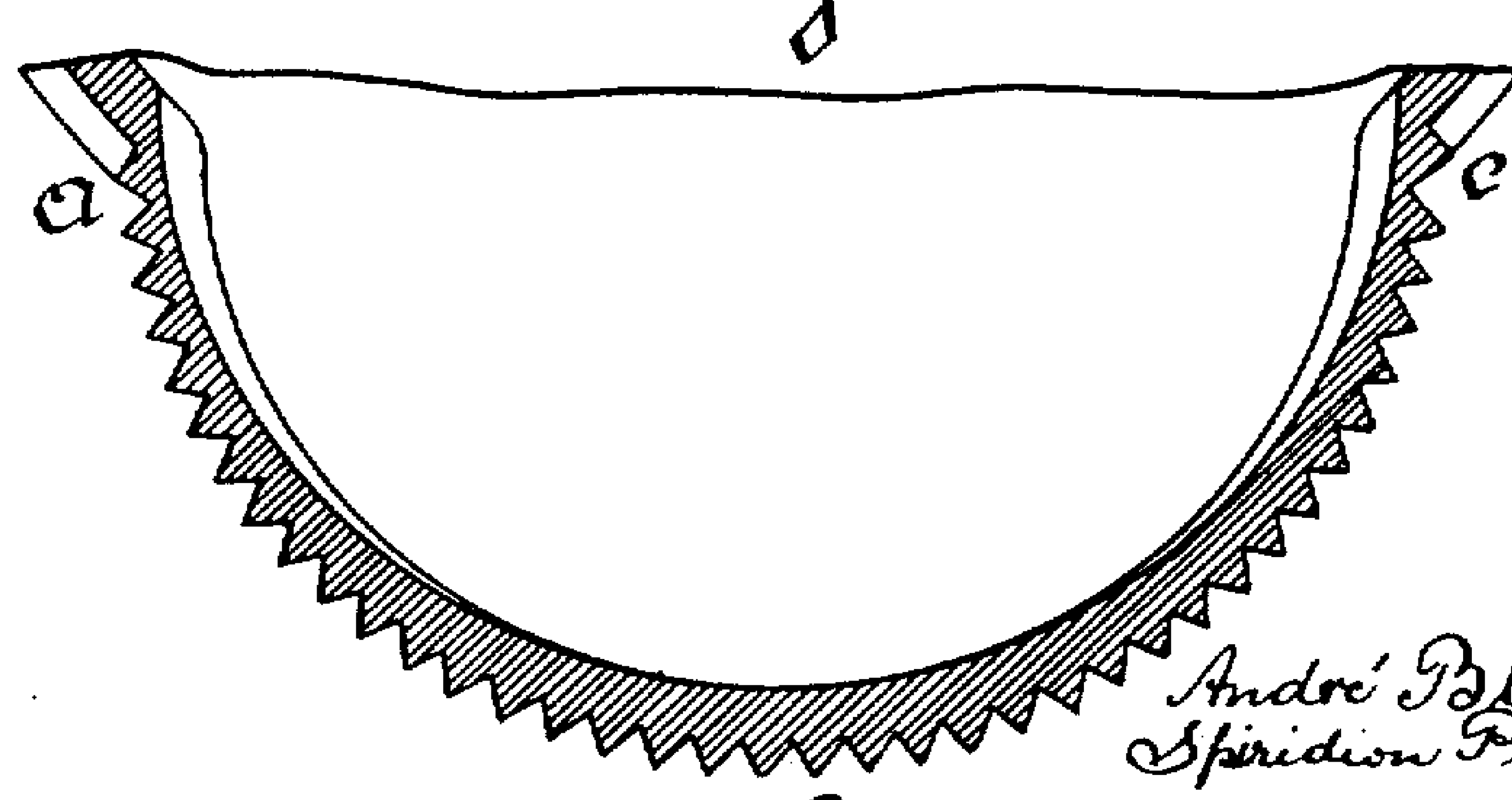


Fig 5.



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(No Model.) 2 Sheets—Sheet 2.

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REFLECTOR.

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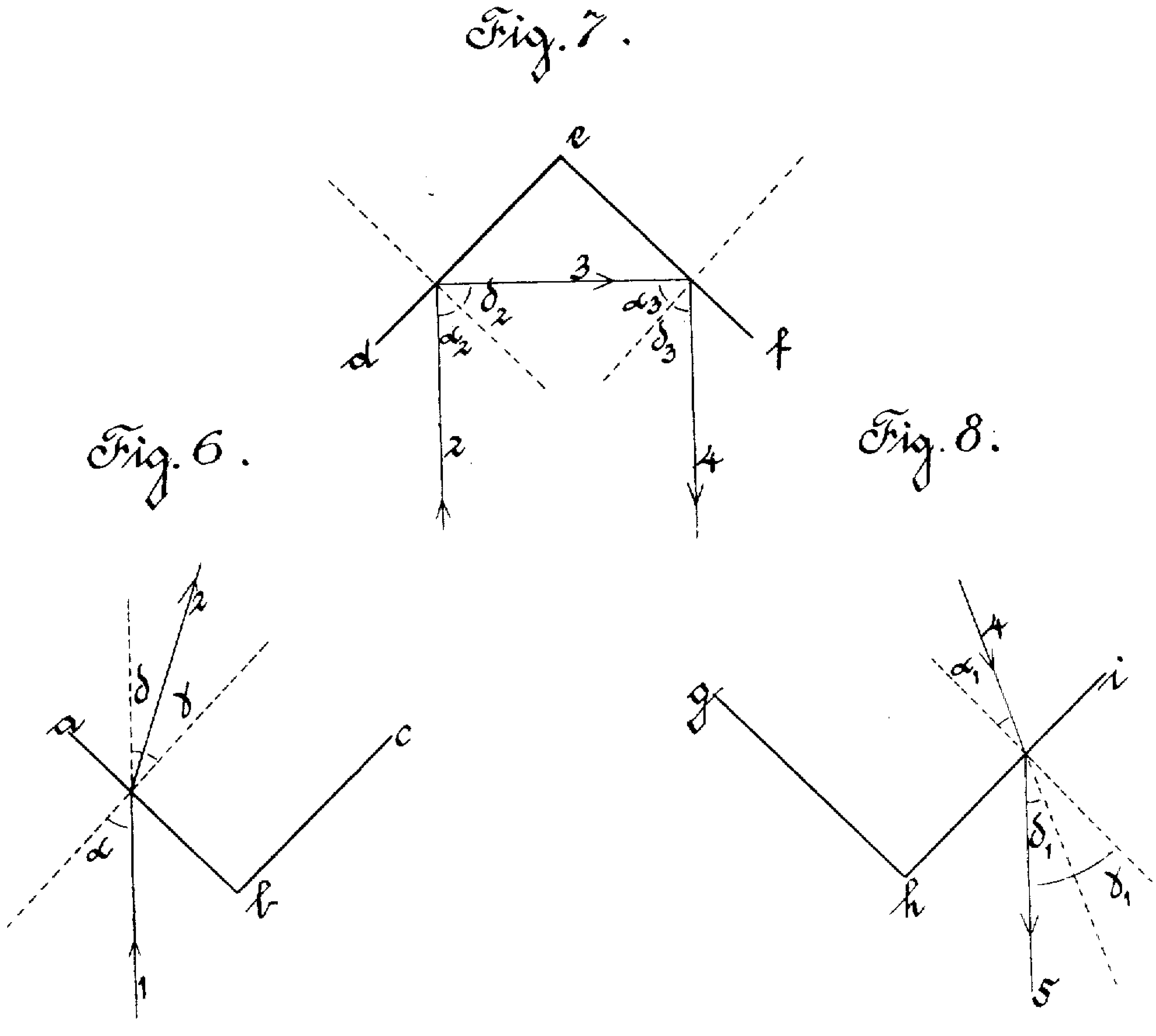

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UNITED STATES PATENT OFFICE.

ANDRÉ BLONDEL AND SPIRIDION PSAROUDAKI, OF PARIS, FRANCE, ASSIGNORS TO LOUIS N. BRUNER.

REFLECTOR.

SPECIFICATION forming part of Letters Patent No. 593,348, dated November 9, 1897.

Original application filed March 30, 1895, Serial No. 543,921. Divided and this application filed May 29, 1896. Serial No. 593,653. (No model.) Patented in Germany March 16, 1893, No. 78,866; in England October 12, 1893, No. 19,185; in Austria-Hungary January 6, 1894, No. 48,988; in Belgium March 13, 1894, No. 108,985, and in France September 30, 1896, No. 233,140.

To all whom it may concern:

Be it known that we, ANDRÉ BLONDEL, a citizen of France, and SPIRIDION PSAROUDAKI, a citizen of Turkey, residing at Paris, France, have invented certain new and useful Improvements in Reflectors; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

This invention has been patented in France September 30, 1896, No. 233,140; in Austria-Hungary January 6, 1894, No. 48,988; in Germany March 16, 1893, No. 78,866; in England October 12, 1893, No. 19,185, and in Belgium March 13, 1894, No. 108,985.

Our invention relates to a globe or disk shaped reflector made entirely of clear glass and designed to be a perfect mirror—that is to say, to reflect all light falling upon it. It is made, preferably, in the form of a segment of a sphere, but it may be of other forms, such as curved or straight tapering. The object is to cause complete reflection of light by its refraction and reflection. Our reflector may be made independent for use alone or it may be molded as a part of a globe. Our reflector is formed with a series of concentric triangular prisms upon the outer or convex surface of the reflector and triangular prisms upon the inner or concave surface at right angles to those upon the convex surface.

Figure 1 is a vertical elevation of the reflector, looking upon its concave surface. Fig. 2 is a vertical elevation viewing the convex surface. Fig. 3 is a sectional view of the reflector on an enlarged scale, showing the form of the exterior prisms. Fig. 4 is a section of the reflector on a large scale, showing the form of the interior prisms. Fig. 5 is a vertical section of a reflector designed to throw the light upward, as shown in the drawings.

Referring to Fig. 1, it will be seen that the prisms in that figure radiate from the center of the convex surface and are triangular in shape.

Viewing Fig. 2, it will be seen that the external prisms are concentric and described from the same center as the center from which the interior prisms radiate.

Viewing Fig. 4, the ray a enters the glass of the interior prism by refraction, penetrates the glass, and strikes upon the exterior surface of the external prism at a'. There it is reflected to the opposite surface of the same prism at b', and thence returns through the glass and out of the interior prism by refraction at b.

Viewing Fig. 5, which is a vertical section of a reflector embodying our invention, the exterior surface A B C has upon it triangular prisms which are concentric and which in the position shown in that figure are horizontal, while the interior prisms are vertical, being largest at the largest diameter of the reflector and reducing in size to their center, where they disappear.

This application is a division or portion of the application, Serial No. 543,921, to us for lamp-globes, which has since been issued as Patent No. 563,836.

For the purpose of clearness we insert a form of calculation which we have used in determining the profiles of the interior and exterior triangular surfaces.

Referring to the drawings, Fig. 6 represents a section of an interior prism; Fig. 7, a section of an exterior prism, and Fig. 8 an interior prism. Rays of light are indicated by solid lines and angles by dotted lines.

Let $a\ b\ c$ and $g\ h\ i$, Figs. 6 and 8, represent the profiles of the interior triangular surfaces, and $d\ e\ f$ the profile of an exterior triangular surface. Let 1 represent the ray before it is refracted by the surface $a\ b$, and 2 the ray after refraction, α the angle of incidence, γ the angle of refraction, and δ the angle of deviation from the direction 1.

From Fig. 6 the angle of deviation is given by the equation

$$\delta = \alpha - \gamma.$$

Whence

(1) $\text{Sin. } \delta = \text{sin. } (\alpha - \gamma) = \text{sin. } \alpha \text{ cos. } \gamma - \text{cos. } \alpha \text{ sin. } \gamma.$

From the law of refraction we have

$$\text{Sin. } \gamma = \frac{1}{n} \text{ sin. } \alpha,$$

where n equals the index of refraction for light when passing from glass into air. Whence

$$\text{Cos. } \gamma = \sqrt{1 - \text{sin.}^2 \gamma} = \sqrt{1 - \frac{1}{n^2} \text{sin.}^2 \alpha}.$$

Substituting these values of sin. γ and cos. γ in (1), we have

$$\text{Sin. } \delta = \text{sin. } \alpha \sqrt{1 - \frac{1}{n^2} \text{sin.}^2 \alpha} - \text{cos. } \alpha \frac{1}{n} \text{ sin. } \alpha$$

or

$$\text{Sin. } \delta = \text{sin. } \alpha \left(\sqrt{1 - \frac{1}{n^2} \text{sin.}^2 \alpha} - \frac{1}{n} \text{ cos. } \alpha \right).$$

From this equation we may compute a useful table of values of δ corresponding to determined values of α. For example, a table for the case of $n = \frac{3}{2}$ follows:

Table I.

	°	′		°	′	″
$\alpha =$	10	..	$\delta =$	3	22	24
	20	..		6	46	40
	30	..		11	36	..
	35	..		12	25	..
	40	..		14	42	51
	41	..		15	5	40
	41	48		15	37	20

From this table we can draw the profile $a\ b$ in such a way as to get any desired angle of deviation δ. Having done so, let 2 represent the ray after refraction.

Now, referring to Fig. 7, draw the surfaces $d\ e\ f$ so as to get the desired direction 4 of the ray after reflection at the two surfaces $d\ e$ and $e\ f$. These directions are readily determined by the law of reflection—namely, the angle of incidence equal the angle of refraction—or from the figure

$$\alpha_2 = \delta_2$$

and

$$\alpha_3 = \delta_3.$$

Since it is desired that the rays should not be refracted on these surfaces, it is only necessary to so draw them that the angles of incidence α_2 and α_3 will be greater than forty-five degrees. Having drawn the surfaces $d\ e$ and $e\ f$ so as to give the desired direction 4 of the ray, all that is now necessary is to draw the surface $h\ i$ of the interior profile Fig. 8 in such a direction as to give the desired direction 5 of the ray after refraction. Let 4 be the direction of the ray in the glass before coming to the surface $h\ i$, α_1 the angle of incidence, γ_1 the angle of refraction, and δ_1 the angle of deviation from the direction 4. From the figure

$$\delta_1 = \gamma_1 - \alpha_1.$$

Whence

(2) $\text{Sin. } \delta_1 = \text{sin. } (\gamma_1 - \alpha_1) = \text{sin. } \gamma_1 \text{ cos. } \alpha_1 - \text{cos. } \gamma_1 \text{ sin. } \alpha_1.$

From the law of refraction we have

$$\text{Sin. } \gamma_1 = n \text{ sin. } \alpha_1,$$

where n equals the index of refraction for light when passing from glass into air. Whence

$$\text{Cos. } \gamma_1 = \sqrt{1 - \text{sin.}^2 \gamma_1} = \sqrt{1 - n^2 \text{sin.}^2 \alpha_1}.$$

Substituting these values of sin. γ_1 and cos. γ_1 in equation (2) we have

$$\text{Sin. } \delta_1 = n \text{ sin. } \alpha_1 \text{ cos. } \alpha_1 - \text{sin. } \alpha_1 \sqrt{1 - n^2 \text{sin.}^2 \alpha_1}$$

or

$$\text{Sin. } \delta_1 = \text{sin. } \alpha_1 \left(n \text{ cos. } \alpha_1 - \sqrt{1 - n^2 \text{sin.}^2 \alpha_1}\right).$$

From this equation we may complete a useful table similar to Table I of values of δ_1 corresponding to determinate values of α_1. For example,

Table II.

	°	′		°	′	″
$\alpha_1 =$	10	..	$\delta_1 =$	5	5	52
	20	..		10	51	57
	30	..		17	35	25
	35	..		24	21	31
	40	..		34	37	..
	41	..		38	46	..
	41	48		48	11	20

Now from this table we can draw the profile $h\ i$ in such a way to get any desired angle of deviation δ_1. For the refracting-surfaces shown in Figs. 6 and 8 it is necessary to draw them so that there will be no reflection of the rays, and this is accomplished by placing them at such an angularity with the rays 1 and 4 that the angles of incidence α_2 and α_3 are less than forty degrees. Since the triangular surfaces are small, all of the rays striking any one of them are supposed to be parallel. This makes the construction quite simple, as all the rays coming in contact with any surface remain parallel after both refraction or reflection.

To construct the refracting and reflecting surfaces in the manner above explained, the diffusion of the light is of course predetermined. In other words, the directions 5 of the rays after the last refraction are predetermined. It is then only necessary to construct the surfaces in such a way as to give the predetermined directions to the rays.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. A reflector made of clear or transparent glass having flutings on its opposite faces, the flutings on one face being arranged at about

right angles to the flutings on the other face and the profiles of said flutings being triangular.

2. A reflector made of clear or transparent glass, a portion of which is provided on its exterior with horizontal flutings, the profiles of which are triangular and the interior surface of which is provided with a series of vertical flutings, the profiles of which are triangular.

3. A reflector made of clear or transparent glass which is convex on one side and concave on the other, and having flutings on its concave and convex surfaces, said flutings being arranged at about right angles to one another, the profiles of said flutings being triangular.

4. A reflector made of clear or transparent glass concave on one side and convex on the other, having triangular concentric prisms upon its convex surface, and having flutings upon its concave surface which radiate from the center of the circles of the exterior prisms.

5. A reflector made of clear or transparent glass, being concave upon one side and convex upon the other, having triangular concentric prisms of uniform shape on its convex surfaces, and having on its concave surface a series of triangular prisms which radiate from the center of the circles of the exterior prisms.

In testimony whereof we affix our signatures in presence of two witnesses.

ANDRÊ BLONDEL.
SPIRIDION PSAROUDAKI.

Witnesses:
G. DE MESTRAL,
CLYDE SHROPSHIRE.