

350-286

EXAMINER'S ROOM.

(No Model.)

C. S. HASTINGS.

ERECTING PRISM.

No. 586,708.

Patented July 20, 1897.

Fig. 1.

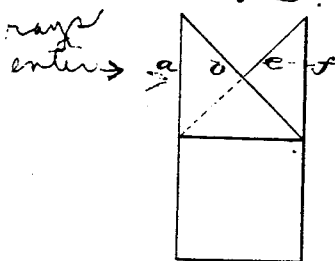


Fig. 2.

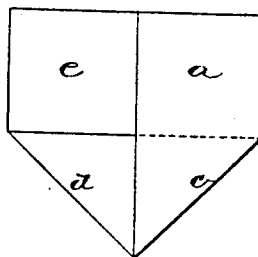


Fig. 3.

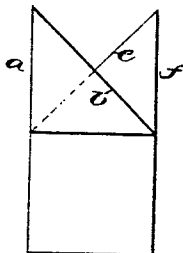


Fig. 4.

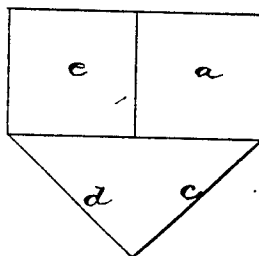


fig 1-4
prior art

Fig. 5.

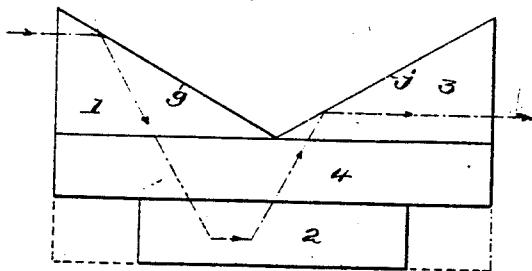
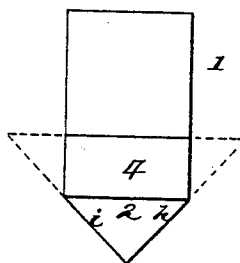
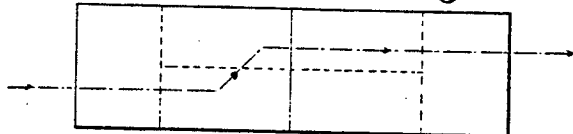


Fig. 6.



Reflected 45°

Fig. 7.



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Br. 17,098-1897

THE NORMAN PETERS CO. PHOTO-LITHO. WASHINGTON, D.C.

UNITED STATES PATENT OFFICE.

CHARLES S. HASTINGS, OF NEW HAVEN, CONNECTICUT.

ERECTING-PRISM.

SPECIFICATION forming part of Letters Patent No. 586,708, dated July 20, 1897.

Application filed May 5, 1897. Serial No. 635,228. (No model.)

To all whom it may concern:

Be it known that I, CHARLES S. HASTINGS, a citizen of the United States, residing at New Haven, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Erecting-Prisms; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the drawings forming a part of this specification, and to the figures and letters of reference marked thereon.

This invention relates to a new and improved optical appliance to which the name "erecting-prism" has been applied, and which is designed to change any optical image, real or imaginary, one hundred and eighty degrees in its own plane without material distortion or lateral displacement.

The said invention consists in certain new arrangements and combinations of reflecting surfaces or prisms, as will hereinafter more fully appear, the novel features being pointed out in the claims.

In the accompanying drawings, illustrating the preferred form of embodiment of the said invention, Figure 1 is a side elevation, and Fig. 2 an end view, of an old form of erecting-prism. Fig. 3 is a side elevation, and Fig. 4 an end view, of a modified and improved construction of the prism, Fig. 1. Fig. 5 is a side elevation, Fig. 6 an end view, and Fig. 7 a plan view, of the new inverting or erecting prism.

Similar figures and letters of reference in the several figures indicate the same parts.

One of the principal and most important applications of the new erecting-prism is in connection with telescopic instruments, as a substitute for the inverting lens or lenses heretofore commonly employed for converting inverting-telescopes, large or small, into erecting (terrestrial) telescopes. As is well known, the most perfect refracting-telescope which has heretofore been constructed presents to the eye of the observer an inverted image. Since this is immaterial in an astronomical use where everything should be sacrificed to perfection of definition, such telescopes, which, moreover, are the simplest in construction, are called "astronomical" telescopes; but inverted aspects of terres-

trial objects are ordinarily not acceptable to any except the very small group of philosophers who have succeeded in emancipating themselves from the purely arbitrary conceptions of up and down. Hence it is usual to employ some means for correcting this perverted condition of affairs as it appears to the majority.

There are two methods in general use for modifying the telescope to meet the wants of the larger portion of mankind not included in the class defined above—namely, by using (a) a negative (*i. e.*, essentially concave) lens at the proper distance for distinct vision inside the focus of the telescopic objective, or (b) by replacing the simple ocular of the astronomical telescope by a more complex one, which is in fact a compound microscope, and thus yields an inverted view of the inverted image.

The first-named type is known as the "Galilian" telescope and is universally familiar in its use in opera-glasses. The second type is known as the "terrestrial" telescope or "spy-glass." The objection to type a is the smallness of the field of view, both absolute and apparent, which they possess. This fault is so serious that only very low magnifying powers are generally practicable, say up to five or six diameters. The objections to type b are two—first, a very material reduction in optical definition, and, second, an inordinate increase in length unless relatively high powers be employed.

There is an entirely distinct method of inverting the image—namely, by oblique reflections from plane surfaces. This has been accomplished by the employment of two polyhedra cemented together, as represented in Figs. 1 and 2, the rays of light entering at a being reflected by the surfaces b, c, d, and e and emerging at f.

On account of the technical difficulties in making this prism the improved form represented in Figs. 3 and 4 is to be preferred, it being constructed of three rectangular prisms cemented together, two of said prisms being of like dimensions and the third larger, as represented in the drawings.

There are general objections to all of these forms of inverting-prisms—namely, their

width and the fact that the image is displaced laterally by a distance depending upon the size of the erecting-prism. This last-named property is especially inconvenient when the prisms are to be used in binocular telescopes. The new type of erecting or inverting prisms illustrated in Figs. 5, 6, and 7 obviates the defects mentioned.

In the preferred form shown it may be said to comprise three prisms 1, 2, and 3, furnishing the four reflecting-surfaces g , h , i , and j . The prism 2 is a right-angle prism—that is to say, its reflecting-surfaces h i are at an angle of ninety degrees, while the angles of prisms 1 and 3 admit of a wide range of variation, but for most purposes the thirty degrees, sixty degrees, and ninety degrees shown will be found preferable.

The prisms 1 and 3 are erected one behind the other and extend equally on opposite sides of the line of intersection of the two planes forming the reflecting-surfaces h i of prism 2, so that the rays of light entering prism 1 will emerge from prism 3 in inverted position, but without lateral displacement beyond such as is due to the inversion of the image. This is indicated by the dotted lines in Figs. 5 and 7, representing the course of a single ray of light traversing the prism.

Having determined upon the angles and dimensions of prisms 1 and 3, the dimensions of prism 2 are determined by considerations which would at once be obvious to any skilled optician. Thus, under the conditions illustrated, the prism 2 would be of the dimensions indicated by dotted lines in Fig. 6, in which case the prisms 1 and 3 might be cemented directly to the upper surface of prism 2, but as this would involve an unnecessary and useless amount and width of material comprising the right-angle prism 2 the excess at the sides, included in dotted lines, may be removed or omitted. So, too, the end sections of prism 2, included in dotted lines, are unnecessary and may be omitted, and all that part intermediate the triangular section bounded by full lines indicating prism 2 proper and the two prisms 1 and 3 may be omitted without departing from the spirit of the present invention; but it is preferred for obvious reasons that this intermediate space should be filled so as to eliminate reflecting-surfaces. Hence it is preferred to make the prism 2 smaller—that is, proportionally, as indicated in the drawings—and fill the interval between it and the prisms 1 and 3 with a parallel-sided plate 4.

As to prism 2, it may be said that the right angle must be very accurate—say to within one minute of arc—but the other angles admit of errors vastly greater than this without material injury to the performance.

Although in the preferred construction the new erecting-prism is made up of four pieces of glass cemented together, it is perfectly evident that, whether made in one, two, or more parts, so long as the four reflecting-surfaces

are caused to occupy substantially the relations indicated its performance will be substantially the same. Thus, as hereinbefore explained, the three prisms 1, 2, and 3 may be employed alone or in combination with the parallel-sided plate 4. Prism 2 and plate 4 may be combined as one piece of glass, or one or both of the prisms 1 and 3 may be formed integral with plate 4. Prism 1 or 3, a portion of plate 4, and the whole of prism 2 might be made from one piece of glass and the other prism 1 or 3 and the remainder of plate 4 of another. Finally, the whole might be formed of a single piece of glass, although there would in such case be great technical difficulties in construction experienced. It may be found advantageous to cover all the reflecting-surfaces with a coating of silver or other reflecting material to protect them from soiling, &c.

It has not been considered necessary to illustrate the manner of applying the new erecting-prism to a telescope, as this will readily be understood by any one skilled in the art, nor is it to be understood that the new prism is limited in use to such instruments, as it is obvious that it could be employed to advantage in other instruments and under different conditions—as, for example, in dissecting-microscopes, &c.

Upon comparison with the older forms of erecting-prisms illustrated in Figs. 1 to 4, inclusive, it will be noticed that the new prism presents this point of great importance and advantage, it preserves the axial alinement of the lenses employed, and it does not effect lateral displacement of the object as viewed in the ocular. This is due to the fact that the two reflecting-prisms 1 and 3 are arranged and disposed longitudinally of prism 2, with their reflecting-surfaces g and j extending across both reflecting-surfaces h i of said prism 2, so that the ray of light reflected by surface g or j on one side of the median line will be directed against surface h and be reflected laterally against surface i , while the rays reflected on the opposite side of the median line will be directed against surface i and be reflected laterally onto surface h , the rays crossing within prism 2 after reflection from g or j and finally emerging with a lateral displacement just proper to inversion of image only and which therefore vanishes for an axial ray.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. An erecting system or apparatus, such as described, the same comprising four reflecting-surfaces, of which the intermediate surfaces are two planes intersecting at an angle of substantially ninety degrees, and the first and fourth surfaces are arranged one behind the other, in the direction of movement of light through the system, with the line of intersection of their planes substantially at right angles to the line of intersection of the intermediate surfaces, said first and fourth

surfaces extending across and on opposite sides of the line of intersection of the intermediate planes; substantially as described.

2. An erecting system or prism, such as described, the same comprising four reflecting-surfaces, *g*, *h*, *i* and *j*, of which the intermediate surfaces *h* and *i* are arranged on intersecting planes, and the first and fourth surfaces, *g* and *j*, are arranged in line longitudinally of said surfaces *h* and *i*, said surfaces *g* and *j* constituting converging planes lying transverse to and extending on opposite sides of the line of intersection between said surfaces *h* and *i*.

3. An erecting system of prisms, such as described, combining in its structure a prism 2, and two prisms 1 and 3, the latter arranged

in line longitudinally of prism 2, with their reflecting-surfaces extending laterally across both reflecting-surfaces of said prism 2.

4. The combination to form an erecting-prism such as described, of the two reflecting-prisms 1 and 3, located one in front of the other, a right-angle prism 2, and a parallel-sided plate 4, interposed between said prisms 1, 3, and prism 2, the latter arranged with the line of juncture of its reflecting-surfaces in a plane bisecting both prisms 1 and 3; substantially as described.

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Witnesses:

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