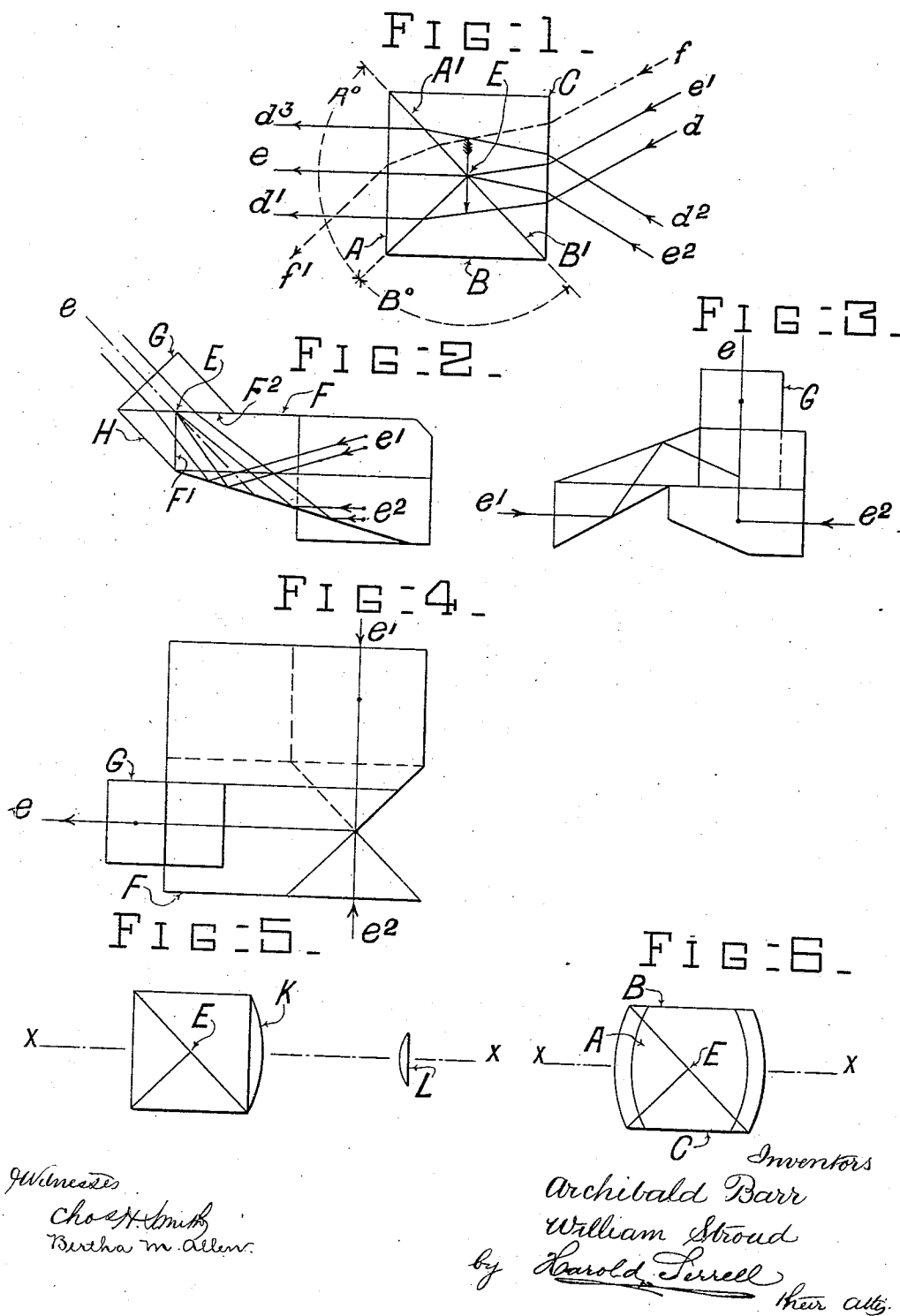


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SINGLE OBSERVER RANGE FINDER.
APPLICATION FILED DEC. 29, 1908.

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2 SHEETS—SHEET 1.



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FIG:7.

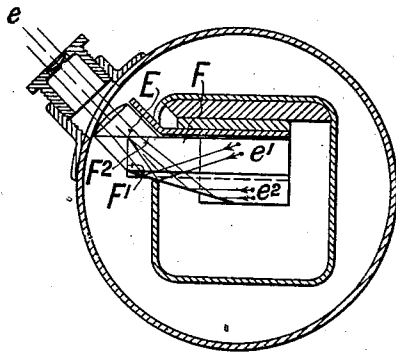


FIG:8.

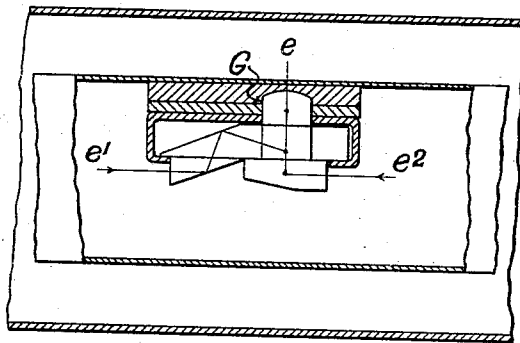
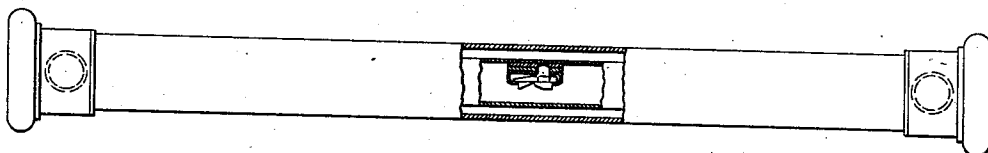


FIG:9.



Witnesses

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UNITED STATES PATENT OFFICE.

ARCHIBALD BARR AND WILLIAM STROUD, OF ANNIESLAND, GLASGOW, SCOTLAND.

SINGLE-OBSERVER RANGE-FINDER.

941,125.

Specification of Letters Patent.

Patented Nov. 23, 1909.

Application filed December 29, 1908. Serial No. 469,817.

To all whom it may concern:

Be it known that we, ARCHIBALD BARR and WILLIAM STROUD, subjects of the King of Great Britain and Ireland, and both of Caxton street, Anniesland, Glasgow, Scotland, have invented new and useful Improvements in Single-Observer Range-Finders, (for which we have made application for a patent in Great Britain, No. 9,906, bearing date May 7, 1908,) of which the following is a specification.

In single observer rangefinders working on the coincidence principle the required division of the two partial images has sometimes been effected by the use of what may be termed a separating prism, which in form comprises two surfaces which meet and produce what may be termed a separating edge. In application the separating prism is introduced to intercept the two beams of rays which approach the separating prism from different directions to form the two partial images of the object observed, the separating prism being so arranged that only the rays which form that portion of one of the images which falls above the separating edge are directed to an eyepiece while the rays forming the supplementary portion of the other image which fall below the separating edge are directed to the eyepiece. The separating edge is placed at or near the focal plane of the objectives so that it is seen in focus, or nearly so, when the images are in focus. The two partial images when brought into coincidence in the operation of using this type of instrument produce a complete image with the separating line across it.

In some examples of separating prisms as at present constructed the separating edge is formed at the meeting of two plane surfaces of glass exposed to the air and consequently liable to receive a deposit of dust, moisture, or other foreign matter in or near the focal plane of the instrument, and are also liable to damage in cleaning. In other cases the separating edge has been formed by the meeting of two reflecting surfaces on a piece of metal which surfaces in like manner are subject to a deposit of foreign matter and to tarnishing. In other cases again the separating edge has been formed by the meeting of two internally reflecting surfaces of glass which, if silvered are liable to show defects in the silvering, or if unsilvered to show de-

posited moisture or other foreign matter. Moreover an exposed separating edge is liable to be damaged and the surfaces forming it to become scratched.

This invention relates to the production of separating devices for use in optical instruments and particularly adapted for use in single observer rangefinders working on the coincidence principle, which in construction comprise surfaces which meet to form a separating edge, and the object of the invention is to afford protection to the surfaces which meet to form the separating edge, to produce in some cases a more perfect edge, to prevent the deposit of foreign matter in or near the plane of the edge, to protect the separating edge and further to reduce the loss of light by reflection which may occur at the surfaces which meet to form the separating edge.

In the construction of separating devices according to this invention the separating edge is formed in the interior of a compound block of glass, quartz or other substance of suitable transparency, hereinafter referred to as glass, with no exposed surface sufficiently near to the focal plane to show in focus, or in approximate focus, any foreign matter deposited on the exposed surfaces.

Some examples of construction will now be described with reference to the accompanying drawings in which—

Figure 1 shows one form of separating device constructed according to this invention. Figs. 2, 3, and 4 are views illustrating the invention embodied in construction with a set of eyepiece prisms. Fig. 5 shows a separating device with one face ground to a spherical form, and Fig. 6 shows a separating device with two spherical faces. Figs. 7, 8 and 9 are sectional views illustrating a rangefinder fitted with a separating device constructed according to this invention embodied in construction with a set of eyepiece prisms as shown in Figs. 2, 3 and 4.

Referring to Fig. 1, A and B are two prisms composed of different kinds of glass having suitably different indices of refraction, A being a prism of suitable angle A° having surfaces which meet to form a separating edge E to which prism is cemented the prism B of an angle B° equal to the supplement of the angle A° (that is

$B^\circ = 180^\circ - A^\circ$). Thus when the two prisms A and B are cemented together, two of their surfaces A^1 and B^1 lie in one plane. This plane in order to make it true and to make the separating edge E free from defects may be ground and polished after the prisms have been cemented together. On to the plane face so formed a third piece of glass C is cemented covering the faces (or parts of them) on each side of the separating edge. In the example of construction illustrated the prism A is of right angled formation and to one of its right angle faces the prism B of equal right angle formation is cemented, and to the plane face A^1 , B^1 , formed by the two prisms, the prism C of right angle form is cemented, the whole forming a compound prism of square section having the separation between the parts as one diagonal plane and one semi-diagonal plane.

In construction the part A is formed of one kind of glass and the parts B and C of a glass of lower refractive index. The three parts may be cemented together with Canada balsam. In Fig. 1 the courses of various rays of light through the compound prism are shown. A ray d is refracted on entering the part C and again refracted on passing from B to A. In the example shown the inclination of d and the refractive indices of the glasses of which the prisms B and A are composed and the angle of the faces of the various parts can be so chosen (on the well-known principle) that the ray will emerge from the piece A in a direction normal to its outer face as shown at d^1 . A ray e^1 parallel to d on incidence, will have the various parts of its course parallel to the corresponding parts of the course of d and emerge as shown at e . Similarly the rays e^2 and d^2 after passing through the compound prism will be caused to emerge as shown at e and d^3 . A ray f , however, coming from above which falls above the edge E takes such a course as is shown by the dotted lines and emerges as shown at f^1 . An observer's eye situated in the course of the emergent rays d^3 , e , d^1 , will not receive the ray f^1 , and therefore of the rays that enter in the direction of d , e^1 and f , only those that pass below E will reach the eye of the observer, those passing above E being carried away so as not to enter the eye. Similarly of the rays entering in direction e^2 d^2 , those that pass above E are brought into the eye while those that pass below E are carried away.

For some purposes the prism A may have a smaller refractive index than the prism B, and in some cases the two prisms B and C may be made of glasses of different refractive index.

If the prism A has a lower refractive index than that of the prisms B and C, the

beams that form the visible parts of the image will not cross each other in approaching the focal plane as indicated at Fig. 1, but the upper entering beam will form the upper part of the visible image and the lower entering beam the lower part of the image.

For some purposes the separating device may in accordance with this invention be formed as part of an eyepiece prism system, one example of which is indicated at Figs. 2, 3 and 4, and shown fitted in a rangefinder in Figs. 7, 8 and 9, which represent an otherwise known form of eyepiece prism system adapted to direct a ray such as e^1 which entering the system horizontally will strike the face F^1 below the separating edge E at a desired inclination, and to direct a ray such as e^2 which entering the system horizontally from the other side will strike the face F^2 above the separating edge E at a similar inclination. In such cases two prisms of another type of glass may be cemented in the manner above described to the prismatic face of the part F, the angles and refractive indices of the glasses used being so chosen as to give the requisite amount of relative refraction to the two rays so that they may emerge as indicated at e at an inclination of say 45° . In the example shown the main parts F of the eyepiece prisms are formed of one kind of glass and two prisms G and H having a higher refractive index than F, are cemented to the face in the manner indicated.

Again, in separating devices according to this invention, one of the surfaces opposite to the separating edge E may be ground as a lens surface, an example of which is illustrated at Fig. 5 which shows a separating device with one face K ground spherical in form so as to form the field lens of an eyepiece of the usual Ramsden type composed of K and the eye lens L. The drawing shows the combination ground externally into the form of a cylinder of which X X is the axis. In other cases both of the surfaces opposite to the separating edge may be formed as lens surfaces, an example of which is illustrated at Fig. 6 which shows a separating device with both the incident and emergent faces ground spherical so as to form a complete eyepiece somewhat of the nature of a Huyghens eyepiece to be used with or without an additional lens or lenses. In this figure the external surface of the combination is supposed to have the form of a rectangular prism.

It is to be understood that this invention is not restricted to the use of right angled prisms such as are shown in the drawings. The angles of the faces of the various parts may be modified according to circumstances and the device may be produced in various forms. Further the construction of a sep-

arating device according to this invention is not confined to the adoption of two kinds of glass. Three or more pieces of glass of three or more kinds may in some cases be used.

What we do claim as our invention, and desire to secure by Letters Patent, is:—

1. A separating device consisting of a combination of prismatic pieces of glass of different refractive indices forming a compound block comprising a separating edge situated in the interior of the block, for the purposes set forth.

2. A separating device consisting of a combination of prismatic pieces of glass of two different refractive indices forming a compound block comprising a separating edge situated in the interior of the block, for the purposes set forth.

3. A separating device consisting of a combination of three prismatic pieces of glass of two different refractive indices forming a compound block comprising a separating edge situated in the interior of the block, for the purposes set forth.

4. A separating device consisting of three prismatic pieces of glass having flat faces at their surfaces of contact comprising a separating edge, lying in a plane in which the partial images may be formed, situated in

the interior of the device, for the purposes set forth.

5. An eyepiece prism system in combination with prismatic pieces of glass constituting a compound block comprising a separating device having its separating edge situated in the interior of the block, for the purposes set forth.

6. An eyepiece prism system in combination with prismatic pieces of glass of different refractive indices constituting a compound block comprising a separating device having its separating edge situated in the interior of the block, for the purposes set forth.

7. An eyepiece prism system in combination with prismatic pieces of glass of two different refractive indices constituting a compound block comprising a separating device having its separating edge situated in the interior of the block, for the purposes set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

ARCHIBALD BARR.
WILLIAM STROUD.

Witnesses:

O. H. PORTER,
J. ALFRED BREWER.