J. N. ARRIAGA.

EYEPIECE FOR MAGNIFYING INSTRUMENTS.

APPLICATION FILED NOV. 2, 1909.

967,143.

Patented Aug. 9, 1910.

2 SHEETS—SHEET 1.

FIG. 1.

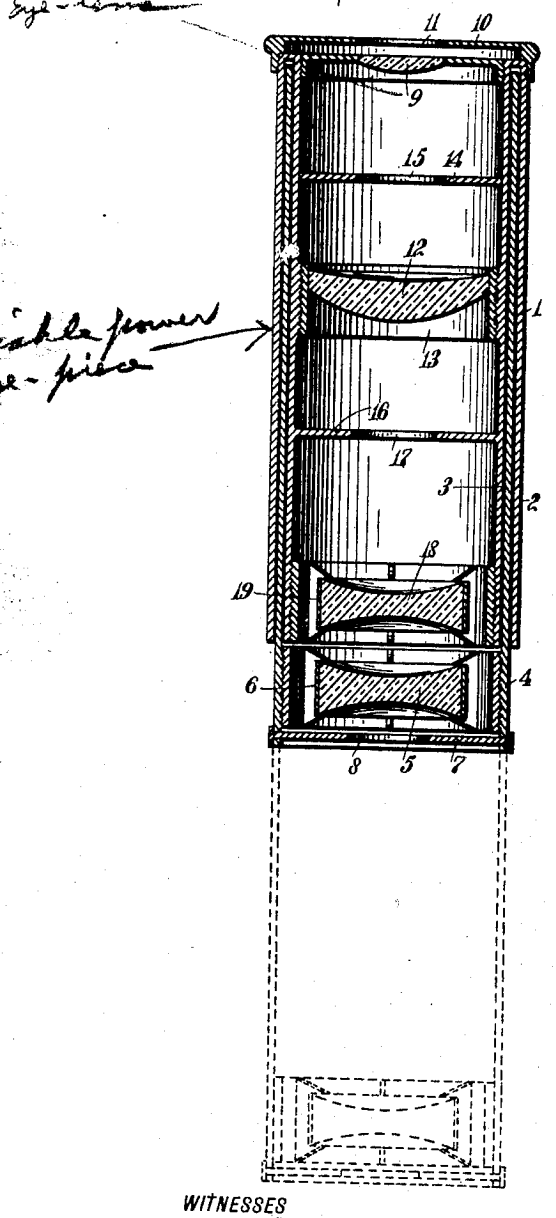
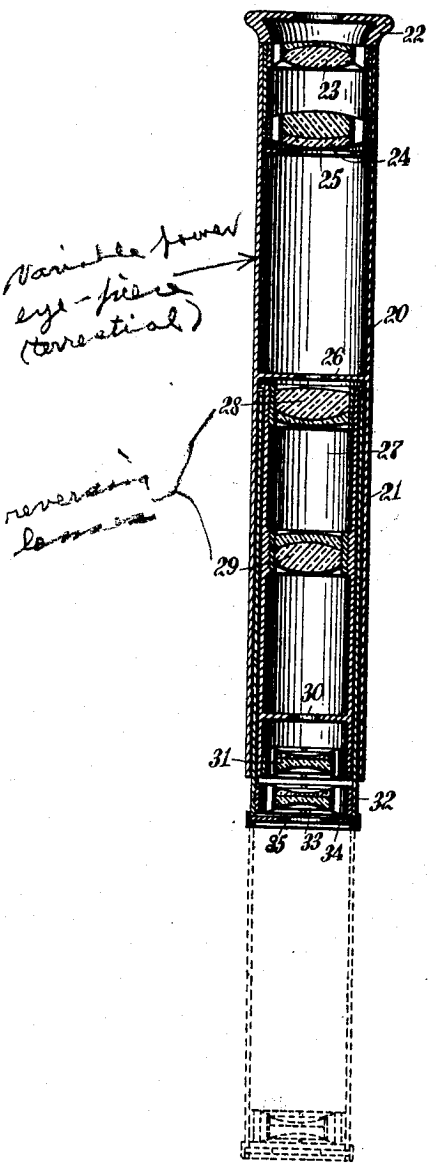


FIG. 2.



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2 SHEETS—SHEET 2.

FIG. 3.

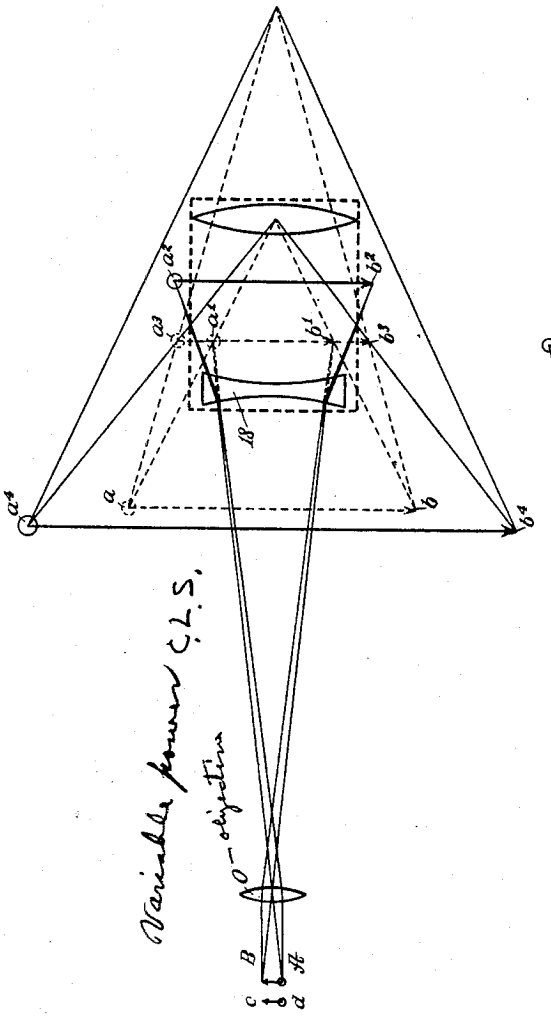
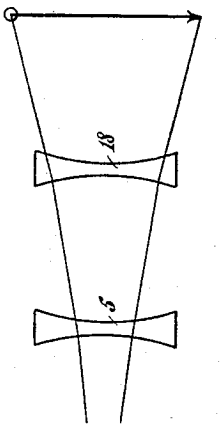


FIG. 4.



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JUAN NEPOMUCENO ARRIAGA, OF MEXICO, MEXICO.

EYEPIECE FOR MAGNIFYING INSTRUMENTS.

967,143. Specification of Letters Patent. Patented Aug. 9, 1910.

Continuation of application Serial No. 420,706, filed March 12, 1908. This application filed November 2, 1909. Serial No. 525,858.

To all whom it may concern:

Be it known that I, JUAN N. ARRIAGA, a citizen of the Republic of Mexico, and a resident of Mexico city, Mexico, have invented a new and Improved Eyepiece for Magnifying Instruments, of which the following is a full, clear, and exact description.

This invention, heretofore described in an application filed March 12, 1908, Serial Number 420,706, of which the present application is a continuation, relates to an eyepiece for magnifying instruments, such as microscopes, telescopes, field glasses, opera glasses, etc.

The object of the invention is to produce an eye-piece of improved construction which will operate to increase the magnifying power of the instrument, and increase, also, its range and capacity for magnifying.

The invention consists in the construction and combination of parts to be more fully described hereinafter and particularly set forth in the claims.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a longitudinal section through an eye-piece embodying my invention, and adapted for use with an astronomical telescope or microscope; Fig. 2 is a similar view, but showing a modified form adapting the device for use as a terrestrial telescope, a field telescope, or field glass; Fig. 3 is a diagram illustrating the mode of operation of a single divergent lens when used according to this invention; and Fig. 4 is also a diagrammatic view showing the manner in which the size of the image is controlled by means of two divergent lenses.

Referring more particularly to the parts, and especially to Fig. 1, 1 represents the barrel or body of the eye-piece, which is formed with a double wall, as shown, so that an outer wall 2 is formed, and an inner wall or cylinder 3. In this way an annular guiding space is formed between the walls, and in this guiding space there is mounted a sliding sleeve 4, which is also of tubular form. This sleeve normally telescopes with the body of the eye-piece, as indicated in full lines in Fig. 1. The lower end of the sleeve which projects from the body of the eye-piece is provided with a centrally disposed lens 5, which is double concave, as shown. This lens does not completely fill the bore of the sleeve, but is of reduced diameter, as shown, being held in position by a suitable ring or thimble 6 which makes a threaded engagement with the bore of the sleeve, as shown. On the end of the sleeve beyond this lens, I provide a removable diaphragm 7 having an opening 8 of reduced diameter, which controls the amount of light passing into the eye-piece.

At the upper end of the barrel 1, that is, at the end to which the eye is applied in using the instrument, a plano convex lens 9 is attached, and over this lens there is seated an eye-cap 10 having an opening 11 which uncovers the lens 9, as shown. Within the barrel or body 1, and near the middle point thereof, as shown, there is mounted a concavo convex lens 12, the said lens being held in position by a removable ring 13 which is threaded in the barrel. Above this lens 12 there is a removable diaphragm 14 having an opening 15 through which the light passes, and below the lens 12 a diaphragm 16 is formed in the barrel, this latter diaphragm having a similar opening 17 to pass the light. The lenses 9 and 12 are such as are commonly used in telescopes, microscopes and similar optical instruments. The image produced by the objective lens is formed at the usual point, just below the diaphragm 16.

In the lower end of the body 1 I provide a double concave lens 18, which is exactly similar to the lens 5, and held in position by means of a ring or spider 19 which screws into the lower end of the barrel 1.

It should be understood that the eye-piece constructed as described, is used in connection with a telescope, microscope or similar optical instrument having an object glass and any usual construction and arrangement of magnifying lenses. In using the eye-piece, the sleeve 4 is adjusted in or out so as to regulate the distance between the movable double concave lens 5 and the fixed double concave lens 18. It will be found that the position of the lens 5 with respect to the lens 18, affects the size of the image produced in the eye, and that the farther apart these lenses are, the larger will this image appear. Therefore, the movable double concave lens not only affords means for increasing the magnifying power, but also

affords means for regulating the degree of magnification or capacity of the instrument, giving it a greater range of diameters of magnifying power.

Referring now to Fig. 2, I shall describe the eye-piece as constructed for use with a terrestrial instrument. With this instrument, the barrel 20 is provided with a double wall 21 only in the lower or outer portion thereof. Near the eye-cap 22 which is attached to the inner or upper end of the barrel, the usual achromatic lenses 23 and 24 are provided. Below the lens 24 a diaphragm 25 is formed in the barrel, with an opening to permit the passage of the light, and a similar diaphragm 26 is formed at about the middle of the barrel. In the interior of the lower portion of the barrel an inner tube or inner wall 27 is fixed. In the upper or inner end of this inner tube an achromatic lens 28 is mounted, and near the middle of the inner tube a similar lens 29 is mounted. These lenses 28 and 29 have the effect of reversing the image which is formed through them, so that an upright image will be seen by the observer. In the lower end of the inner tube 27 a diaphragm 30 is provided, having a small opening to pass the light, as shown, and below this opening, in the extreme end of the inner tube, an achromatic double concave lens 31 is removably mounted. In the guide space in the double wall of the lower end of the barrel, a sliding sleeve 32 is mounted, which is similar to the sleeve 4, and in the lower end of this sleeve a double concave lens 33 is mounted, the said lens being in all respects similar to the lens 31 just above it. The lower end of the sleeve 32 is provided with a suitable cap 34 having an opening 35 through which the light passes. The sleeve 32 is adapted to be drawn out as indicated in the dotted lines, so as to regulate the distance between the two lenses 31 and 33. In this way the size of the image which the observer sees, may be nicely regulated, and at the same time it is magnified. The inner faces of the walls of the sleeves 4 and 32 are made black, also the inner face of the bodies of the eye-pieces, so that no light is reflected from the side walls of the instrument.

It should be understood that the eye-piece shown in Fig. 2 is used in the same manner as the eye-piece shown in Fig. 1, but it is used with terrestrial instruments only.

Although I have shown double concave lenses in the illustrations, it should be understood that I do not limit myself to this particular form, but I may use plano-concave lenses, meniscus lenses, and divergent concavo-convex lenses; that is, I may use any divergent lens.

The manner in which the divergent lens 18 operates to enlarge the image is clearly illustrated in the diagram, Fig. 3. In this diagram the operation of a single divergent lens in enlarging the image is illustrated, and in Fig. 4 the effect of a second lens of the same kind, employed for the same general purpose, is illustrated. In Fig. 3, O represents the objective lens before which the object represented by the line A—B is placed; if the divergent lens 18 were omitted, an image of the object A, B would be formed at a', b' in an inverted position. However, as the luminous rays pass through the lens 18, the convergence of the rays which are united at any point of the image, is decreased so that an enlarged image a^2, b^2 will be formed nearer to the eye, as indicated. This image will be displaced slightly to the rear of the normal plane or focus where the image would have been formed in the absence of the lens 18. Now if the lens 18 were absent, the image a', b' would appear to the eye looking through the eye-piece, as enlarged and located at a, b. In order to bring the image a^2, b^2 into the plane of the image a', b', it would simply be necessary to move the instrument away from the object A, B slightly to some such position as that indicated by the line c, d. In other words, the relative position of the object is changed to advance the image a^2, b^2 to the point a^3, b^3. In this way the lens 18 operates to produce an enlarged image a^3, b^3, and this enlarged image is in the plane of the image a', b'; as seen through the eye-piece the image a^3, b^3 appears as an enlarged virtual image indicated by the line a^4, b^4. Thus the magnifying power of the instrument is greatly increased.

Referring to Fig. 4, 18 represents the fixed divergent lens, while 5 represents the movable divergent lens. The movable lens evidently will act upon the luminous rays to diverge them before reaching the lens 18, and the effect of this divergence is greater or less, depending upon whether the lens recedes from or approaches the lens 18, that is, the diverging effect of the lens is greater when the lens 5 is remote from the lens 18, and it is less when the lenses are near to each other.

With an instrument constructed as described, it will therefore be evident that the presence of the fixed divergent lens just before the focal point of the lens 12 will form a greatly enlarged image of the object, and the size of this image may be controlled by means of the movable divergent lens before the fixed divergent lens. In this way the instrument is given great power and great range.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. An eye-piece having a convex lens in combination with a divergent lens placed immediately before the focus of said convex

lens, said divergent lens affording means for decreasing the convergence of the luminous rays and forming an enlarged image.

2. An eye-piece having a convex lens and a divergent lens placed immediately before the focus point of said convex lens, said divergent lens operating to decrease the convergence of the luminous rays, and forming an enlarged image, and a second divergent lens disposed before said first divergent lens, one of said divergent lenses being movable with respect to the other whereby said second lens may increase or decrease the size of the image formed.

88. OPTICS, Telescope.

3. An eye-piece having a convergent lens, and a divergent lens placed immediately before the focus point thereof, to increase the size of the image formed, and a second divergent lens movably mounted before said first divergent lens, adapted to recede therefrom or approach to vary the size of the image formed.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JUAN NEPOMUCENO ARRIAGA.

Witnesses:
FELIX M. ALCEMEUX,
YLDEFONSO F. ORELLEMA.